FEBRUARY 28, 1946

American Machinist

Featuring WORKING OF STAINLESS STEEL

Perfect concentricity is the name for it— and here's the machine that puts it on a production-line basis

Perfect concentricity in a cylinder sleeve is something that doesn't show to the naked eye—but it certainly shows up as a major achievement for the manufacturer. Especially when he can get precision like this on a production-line basis! And he's getting it—with the Heald No. 73 Centerless Internal, a machine that's made-to-order for grinding large cylinders, sleeves and liners, including those with very thin wall sections.

Like all Heald Centerless grinders, the 73 operates on a unique principle. The work-holding unit consists of three rolls, which locate and drive the work from its outside diameter, thus producing perfect concentricity between the ground bore and O.D. Simple—yet this method produces ten-thousandths-of-an-inch accuracy on cylinders from four to eight inches O.D. and up to sixteen inches long. And it pays off in man-hour savings which soon absorb the cost of the equipment.

On hundreds of production lines in many industries, Heald engineering can easily mean the difference between profit and loss—especially in these days when so many other factors may be beyond control. At no obligation, a Heald engineer will be glad to help you find ways to improve your production and lower your costs. For further information, write: THE HEALD MACHINE COMPANY, WORCESTER 6, MASS.

HEALD

means finer precision
. . . lower costs

INTERNAL AND SURFACE GRINDING MACHINES • BORE-MATIC PRECISION FINISHING MACHINES

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American Machinist

MAGAZINE OF METALWORKING PRODUCTION

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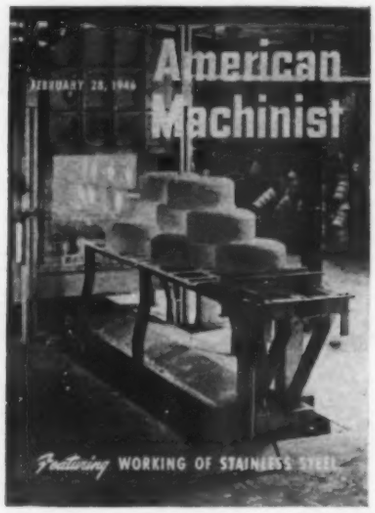
American Machinist Chips

Our Cover Kodachrome . . . The "pots" are really partially-drawn vacuum chambers for water-cooled ignition tubes, made of Stainless Steel (AISI 347, No. 13 gage) for corrosion resistance. After this anneal they go on to deep-drawing in a 40-ton double-action hydraulic press. The Selas gas-fired radiant-heat furnace is at Lalance & Grosjean Co., Woodhaven, N. Y. A shuttle-loaded unit, with platform at each end, its grates can handle 36 cylinders at a time. The photograph was loaned to us by Electro Metallurgical Company.



Coming March 14 . . . For years, metalworking men have agreed that the average age of equipment in small shops is greater than that in large ones. However, until now there has been no real proof.

A special survey conducted by *American Machinist* editors made possible the subdividing of data for plants with over and under 500 workers. The statistics prove previous claims, and provide interesting sidelights. An 8-page special report.

Another article scheduled for the next issue is by S. C. Spaulding, practical metallurgical engineer for American Brass Co. He has worked out a detailed classification for tool steels—something a great many shop men have been waiting for.

Very Special Report . . . Developments in fabrication methods for Stainless Steel received tremendous impetus during the war, resulting in so many changes we felt it was time to revise our first report on the subject . . . and here it is in this issue.

As would be expected, research and visits to manufacturers and fabricators have been extensive over the past six months. Even so, last-minute revisions and amplifications forced Editor Hal Flynn to work all night to complete the section in time. Some tables and nomographic charts were developed by Editor A. J. Holland. To insure accuracy, nomographs were lofted rather than drawn—in one case on a 4X6 ft. section of plywood painted white. Holland did the lofting at home in Westport, Conn., and by working to such a size, insured that a 1/16-in. error would be less than a ten-thousandth in the reproduced smaller chart. But it's quite a trick to carry a 4X6 ft. piece of plywood on a commuter train.

Special Reports Clicking . . . Judging from the letters, wires and reprint orders we've received, *American Machinist's* newly-developed "Reports to the Metalworking Industries" seem to be the type of editorial feature service our readers want.

Already, since Dec. 6, successive issues have brought you in rapid-fire order: 1945 Inventory of Production Equipment (Other Than Machine Tools), How to Lubricate Metalworking Machines, Wage Incentives, Industry Will Need New Equipment to Meet Postwar Competition, Metal Processing, Report on German Industry and bringing us up-to-date with the current section on Stainless Steel. All are available in reprint form.

This method of presenting timely, concise, authoritative editorial reprints at frequent intervals throughout the year represents something quite new. Your comments on the series as a whole or on individual sections will be appreciated.

Craft Pride . . . In these days of labor turmoil, the question of whether craft pride is dead or only dying merits consideration. The views of Whiting Williams, well-known labor relations consultant, will be presented in the lead article in this issue. Among the factors to be discussed will be war-shortened training periods and "de-skilling" of operations, income differences for skilled and unskilled workers, the burning issue of seniority rights, and reduction of permissible apprentices in industry.

Mr. Williams minces no words in discussing his subject and brings up some points that are mighty pertinent to the labor conflict of the day. His knowledge of worker attitude has been drawn direct from the labor field. He has worked in coal mines in Wales, France, Germany and the United States. He has made many fact-finding surveys as an industrial labor relations consultant.

From the Mailbag . . . Here is another comment from a reader on the value of the advertising pages in *American Machinists*

"Have been in the shop here 50 years—40 of these as superintendent. Have been reading American Machinist *practically all of those years. Would feel lost without it. I see everything in it and read most of all articles. In fact, I feel that I am part of the* American Machinist. *I am 70 years old now and expect to work to 80 if I can get the paper." J. E. Stanley, Supt., West Point Foundry & Machine Co., West Point, Ga.*

Announcing A NEW DESIGN GLEASON QUENCHING PRESS

for
Controlled, distortion-free
quenching of:
• Bevel and hypoid gears • Spur gears
• Discs • Liners • Bearing races
• Etc.

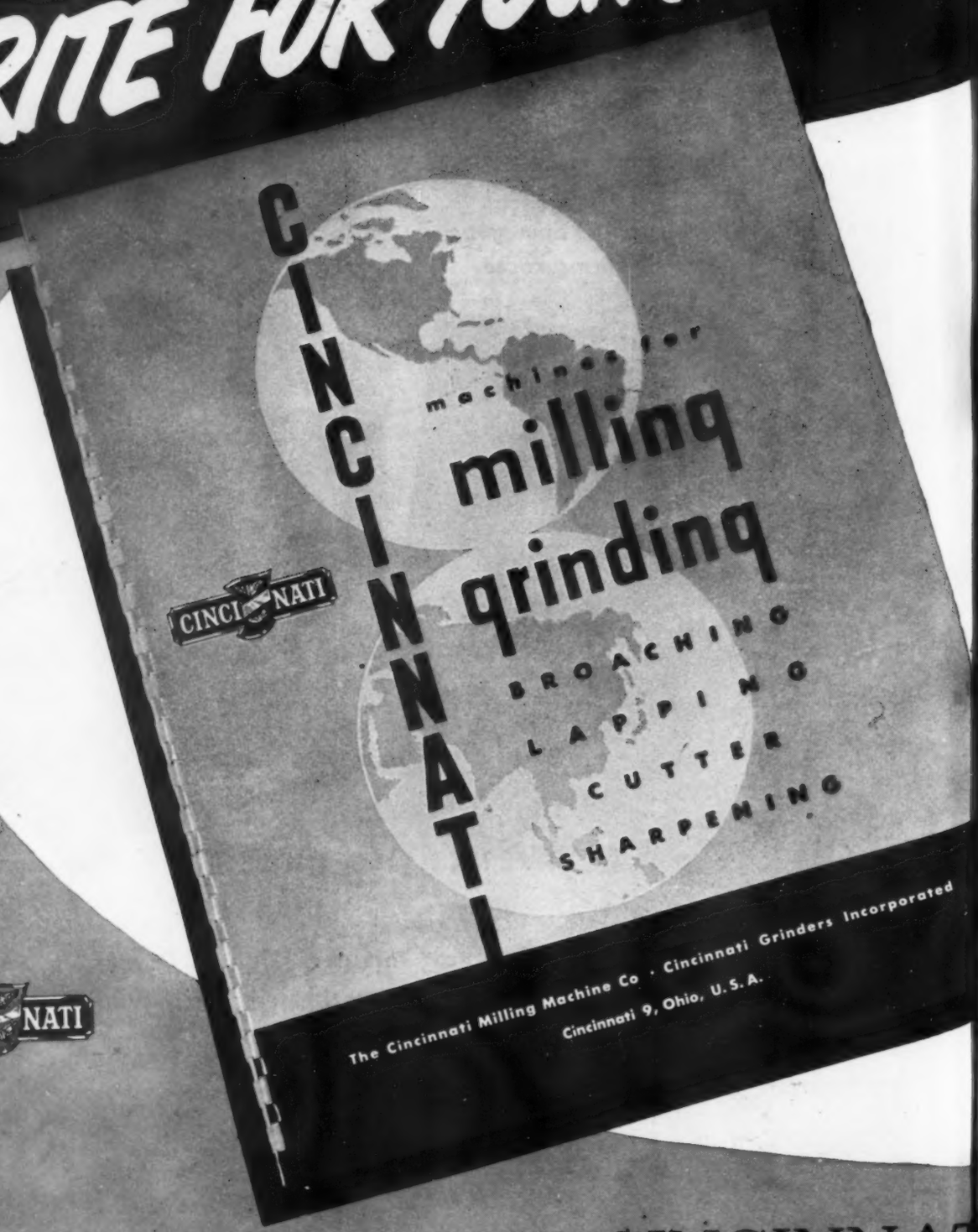
Let us show you how this new Gleason Quenching Press will solve your quenching problems. Write for descriptive literature and send in prints of parts you wish to quench.

GLEASON WORKS

Builders of Bevel Gear Machinery for Over Eighty Years

1000 UNIVERSITY AVENUE, ROCHESTER 3, N. Y., U. S. A.

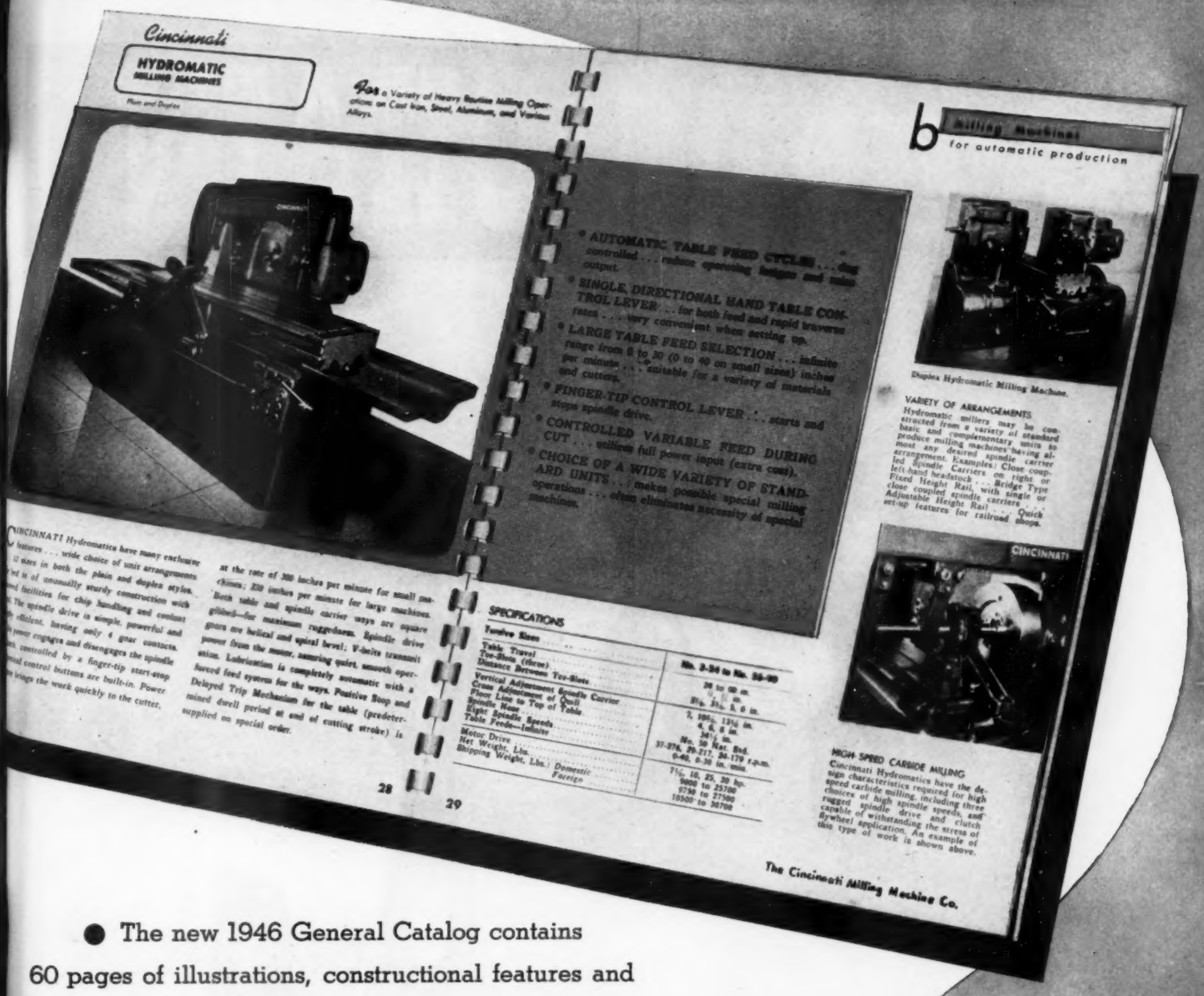
WRITE FOR YOUR COPY



CINCINNATI

THE CINCINNATI
CINCINNATI

OF THIS 1946 CATALOG


Cincinnati
HYDROMATIC
MILLING MACHINES
Plain and Duplex
For a Variety of Heavy Routine Milling Operations on Cast Iron, Steel, Aluminum, and Various Alloys.
• AUTOMATIC TABLE FEED CYCLES . . . that controlled . . . reduce operating fatigue and raise output.
• SINGLE DIRECTIONAL HAND TABLE CONTROL LEVER . . . for both feed and rapid traverse rates . . . very convenient when setting up.
• LARGE TABLE FEED SELECTION . . . infinite range from 0 to 30 (0 to 40 on small sizes) inches per minute . . . suitable for a variety of materials and cutters.
• FINGER-TIP CONTROL LEVER . . . starts and stops spindle drive.
• CONTROLLED VARIABLE FEED DURING CUT . . . utilizes full power input (extra cost).
• CHOICE OF A WIDE VARIETY OF STANDARD UNITS . . . makes possible special milling operations . . . often eliminates necessity of special machines.
CINCINNATI Hydromatics have many exclusive features . . . wide choice of unit arrangements . . . sizes in both the plain and duplex styles. . . . ed is of unusually sturdy construction with ed facilities for chip handling and coolant . The spindle drive is simple, powerful and efficient, having only 4 gear contacts. power engages and disengages the spindle , controlled by a finger-tip start-stop rial control buttons are built-in. Power ng brings the work quickly to the cutter.
at the rate of 300 inches per minute for small machines; 250 inches per minute for large machines. Both table and spindle carrier ways are square gibbed—for maximum ruggedness. Spindle drive gears are helical and spiral bevel; V-belts transmit power from the motor, assuring quiet, smooth operation. Lubrication is completely automatic with a forced feed system for the ways. Positive Stop and Delayed Trip Mechanism for the table (predetermined dwell period at end of cutting stroke) is supplied on special order.
28
29
SPECIFICATIONS
Twelve Sizes
No. 2-36 to No. 36-HP
Table Travel
Two Sizes (three)
Distance Between Two Sizes
Vertical Adjustment Spindle Carrier
Cross Adjustment of Quill
Floor Line to Top of Table
Spindle Nose
Eight Spindle Speeds
Table Feeds—Infinite
Motor Drive
Net Weight, Lbs.
Shipping Weight, Lbs.: Domestic
Foreign
7½, 10, 15, 20 hp.
9800 to 25700
9750 to 27500
10500 to 36700
b Milling Machines for automatic production
Duplex Hydromatic Milling Machine.
VARIETY OF ARRANGEMENTS
Hydromatic millers may be constructed from a variety of standard basic and complementary units to produce milling machines having almost any desired spindle carrier arrangement. Examples: Close coupled Spindle Carriers on right or left-hand headstock . . . Bridge Type Fixed Height Rail, with single or close coupled spindle carriers . . . Adjustable Height Rail . . . Quick set-up features for railroad shops.
CINCINNATI
HIGH SPEED CARBIDE MILLING
Cincinnati Hydromatics have the design characteristics required for high speed carbide milling, including three choices of high spindle speeds, and rugged spindle drive and clutch capable of withstanding the stress of flywheel application. An example of this type of work is shown above.
The Cincinnati Milling Machine Co.

● The new 1946 General Catalog contains 60 pages of illustrations, constructional features and specifications of CINCINNATI Milling, Grinding, Broaching, Lapping and Cutter Sharpening Machines, and their attachments. Write for your copy today! Ask for publication No. M-1420.

AT MILLING MACHINE CO.
AT GRINDERS INCORPORATED
CINCINNATI 9, OHIO, U.S.A.

The Great CHAIN

PUZZLE

If it costs 1 cent to break a link, and 2 cents to weld it again — what is the least you should have to pay for a single length of chain composed of the five segments shown here?

Twelve cents? Try again — the correct answer is less.*

There's a simple moral to this: The obvious way is not always the most economical way.

In the intense competition that lies ahead, costs will make the difference between many a success or failure. Because of this, it will pay you to check *now* on the production efficiency of all metal turning equipment in your plant — and to replace it, if need be, with good War Surplus Machines or new machines.

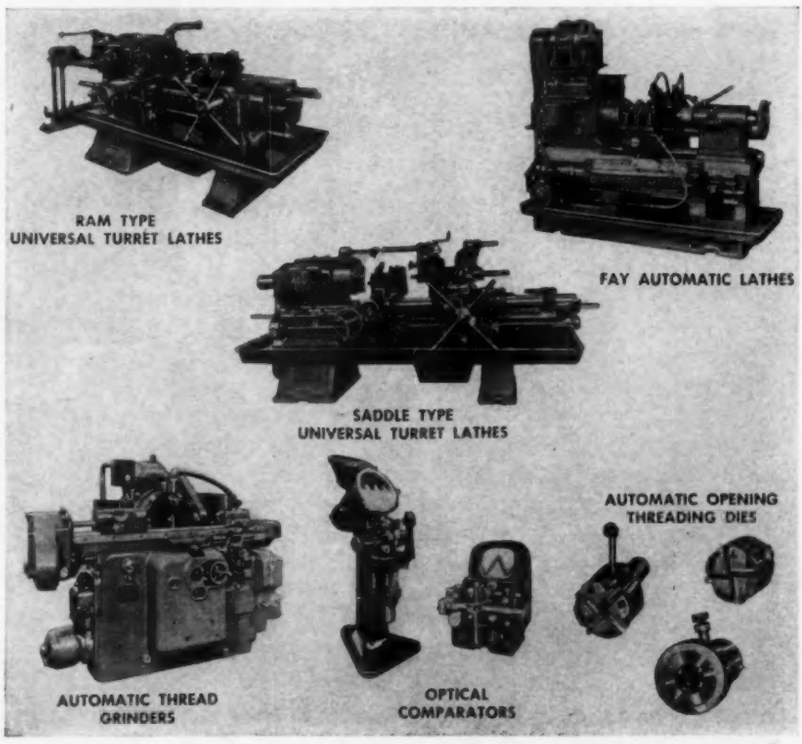
For carbide cutting tools can remove metal from 200 to 500 per cent faster, and there are cases in our files of savings amounting to hundreds of dollars a month on the manufacture of a single part, by the use of Jones & Lamson machines designed specifically for the most efficient use of these tools.

Send for our book, "Welcome to You and Your Problem" — or better, telephone or write today, and a Jones & Lamson engineer will be glad to call and help you.

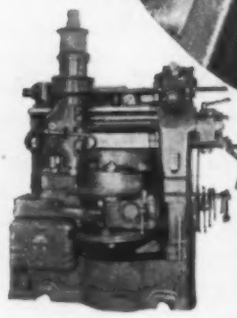
*9 cents

JONES & LAMSON
MACHINE COMPANY
SPRINGFIELD, VERMONT, U. S. A.

Manufacturer of: Universal Turret Lathes • Fay Automatic Lathes • Automatic Double-End Milling and Centering Machines • Automatic Thread Grinders • Optical Comparators • Automatic Opening Threading Dies and Chasers.



FELLOWS METHOD IN



PRESHAVING

the gear on the Fellows Type 6A-Gear Shaper. Limit, 0.002".

FINAL SHAVING

on Fellows No. 8 Gear Shaving Machine. Stock removal, 0.003" to 0.004"; Limit 0.001".

THE FELLOWS METHOD...MACHINES AND TOOLS FOR

CONTROLS *Quiet*

GEARS FOR 4,000 f.p.m. P.L.V.

THE JOB... to produce an Internal Helical Gear that will stand up and be quiet while operating at almost one mile-a-minute pitch line velocity, in the "business end" of a special-type Speed Reduction Motor Drive.

TO MACHINE IT... the precision gear makers at the Paterson, N. J. plant of the Watson-Flagg Machine Company, Inc. knew from experience that the way to control accuracy in the manufacture of such a gear is to cut and finish it by the Fellows Method. And they do it.

THE RESULT IS... a high-accuracy gear that not only is superlatively quiet but, in addition, contributes increased operating efficiency and low operating cost for the unit.

This is but one of many types of gears turned out at Watson-Flagg by the Fellows Method—which helps their products to perform better... quieter.

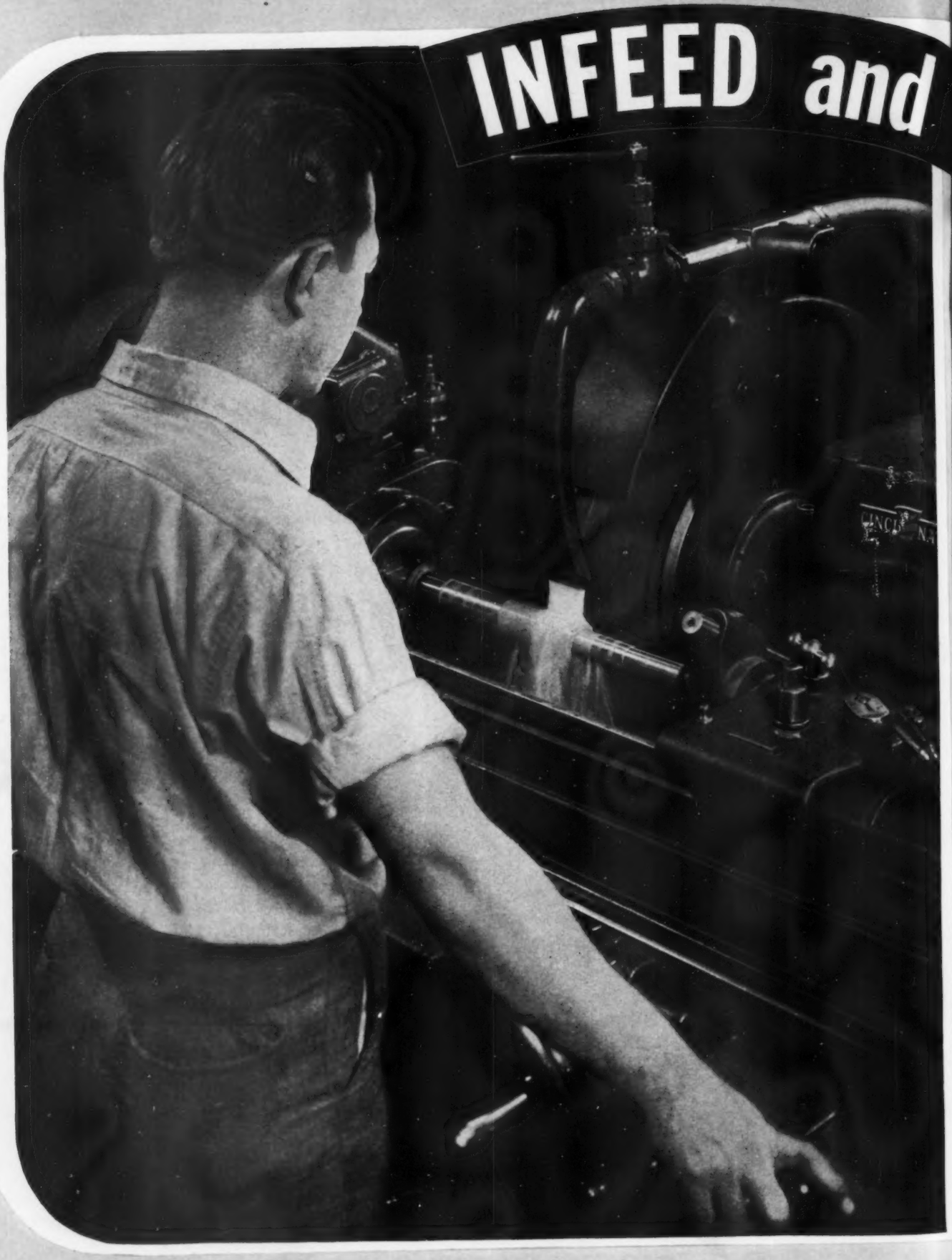
Ask the Fellows Sales Engineer to discuss Fellows equipment in the light of your gear production requirements, or write direct for your complimentary copy of "The Fellows Method". The Fellows Gear Shaper Company, Springfield, Vt., or 616 Fisher Bldg., Detroit, or 640 West Town Office Bldg., Chicago.

GEAR DATA

Material	*#4656 Steel Forging*
Number of Teeth	*138*
Diametral Pitch	*10*
Pitch Diameter	*13.800"*
(.002" to .003" backlash)	
Overall Limit	*±.001"*
Tooth-To-Tooth Spacing Error Held to	*±.0002"*

Fellows

ALL OPERATIONS FROM BLANK TO FINISHED GEAR



CINCINNATI

CINCINNATI

CENTER TYPE GRINDING MACHINES

TRAVERSE GRINDING

on this . . .

CINCINNATI FILMATIC 6" PLAIN HYDRAULIC WITH HAND SERVO INFEED ATTACHMENT

Hand Servo Infeed Attachment controls rapid advance of wheel to work, automatic starting and stopping of coolant flow and work rotation, and rapid retraction after sizing.

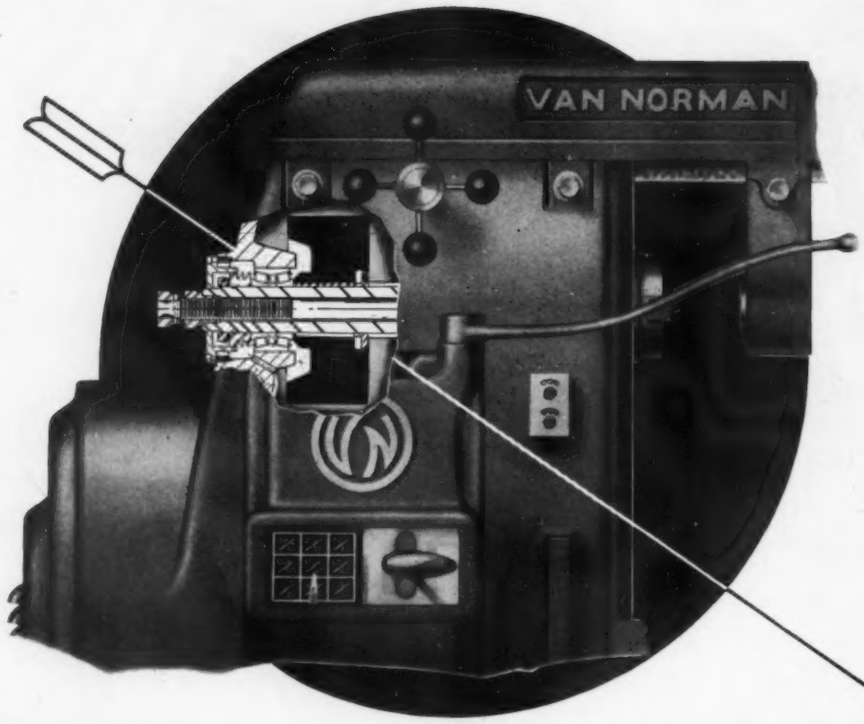
● CINCINNATI 6" and 10"-L Plain Hydraulic Grinding Machines have all the qualifications for precision traverse work. And when equipped with Hand Infeed Attachment these machines become even more useful, because infeed or plunge cut work may then be ground at a high rate of production. Another advantage of the Infeed Attachment is to gain greater space between work and wheel —a safety factor in loading and unloading. ¶ In the illustration on the opposite page this equipment proves very useful in grinding rotor shafts on a CINCINNATI 6" x 30" Plain Hydraulic Grinder. The center section of the shaft, slightly longer than the width of the wheel, is infeed ground to size. Then the table traverse is engaged and the remaining length of the center section diameter is ground. Production averages 60 parts per hour. Precision grinding machines of this type may be useful in handling some of your grinding operations faster and more economically. Write for descriptive literature.

CINCINNATI 6" Plain Hydraulic Grinder. Also available in 10"-L size and between-center lengths of 18" and 30". A copy of Catalog No. G-537, containing complete specifications, will be sent on request. Sweet's Catalog File gives a brief description of all CINCINNATI Grinding Machines.

RINDERS INCORPORATED

INNATI 9, OHIO, U. S. A.

ERLESS GRINDING MACHINES • CENTERLESS LAPPING MACHINES



Built-in Flywheel

INCREASES CUTABILITY OF NEW

VAN NORMAN

No. 2 Medium

HORIZONTAL MILLER

Table: 50"x10"— Motor: 5 HP

Among the outstanding design features of the *new* Van Norman No. 2 Medium is the heavy *built-in* spindle flywheel . . . an exclusive Van Norman advantage. Mounted on the spindle inside the column, it provides smooth transmission of power to the cutter. It improves cutability and assures a smooth finish on the work. In addition, the flywheel increases the work range of the miller by enabling operators to handle a larger variety of work.

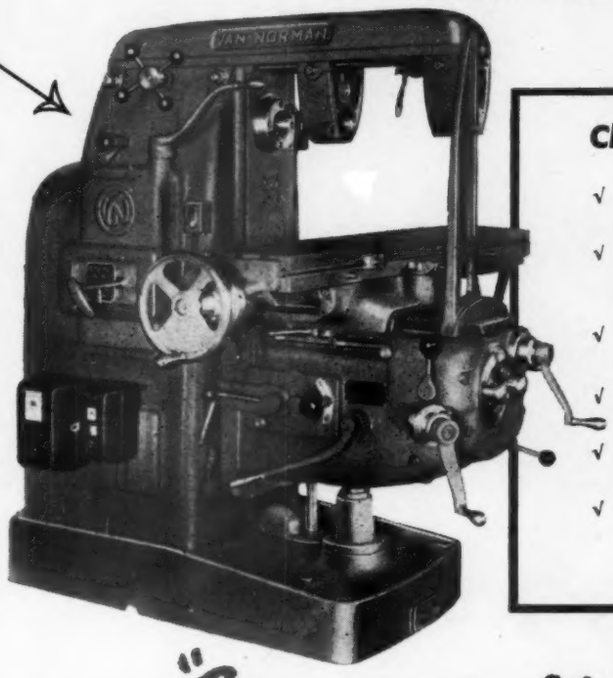
The No. 2 medium has front and rear directional control of all power feeds, as well as six-way rapid traverse. This permits operators to operate the machine from either position. It assures maximum safety and increases operator output by minimizing fatigue.

The exclusive Van Norman single lever speed selector provides quick selection of 18 spindle speeds. The rotary-type feed selector and high-low series feed selector permits easy selection of 12 feeds. Other new and improved construction and operating advantages include heavy column and base, large hardened alloy steel gears, hardened multi-splined shafts, taper roller bearings and automatic lubrication.

The new Van Norman No. 2 medium is available with plain or universal saddle. Write for complete information today.

VAN NORMAN COMPANY

SPRINGFIELD 7, MASSACHUSETTS



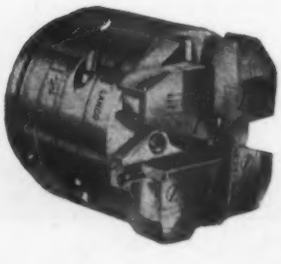
Check These Plus Advantages

- √ Built-in spindle flywheel
- √ Front and rear directional power controls
- √ New heavy column and base
- √ Single lever speed selector
- √ Large diameter cutter spindle
- √ Overarm pilot wheel
- √ Large easy-to-read dials
- √ Heavy ram-type overarm
- √ Automatic lubrication
- √ Hardened alloy steel gears with large tooth area
- √ Six-way rapid traverse

"It pays to Van Normanize"

Official U. S. Navy Photograph

American submarines are powered by Diesel engines when operating on the surface. Here machinist mates check the mammoth twin Diesels in the engine room of a U. S. sub.



LANDIS

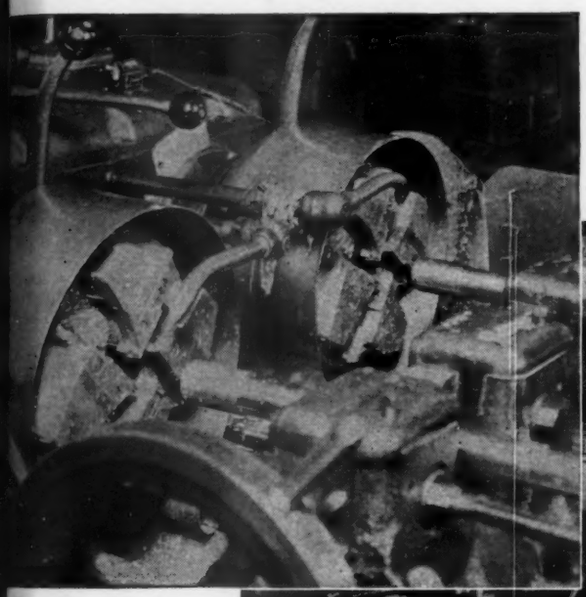
Diesel Engine Cylinder Studs *threaded by* LANDMACO

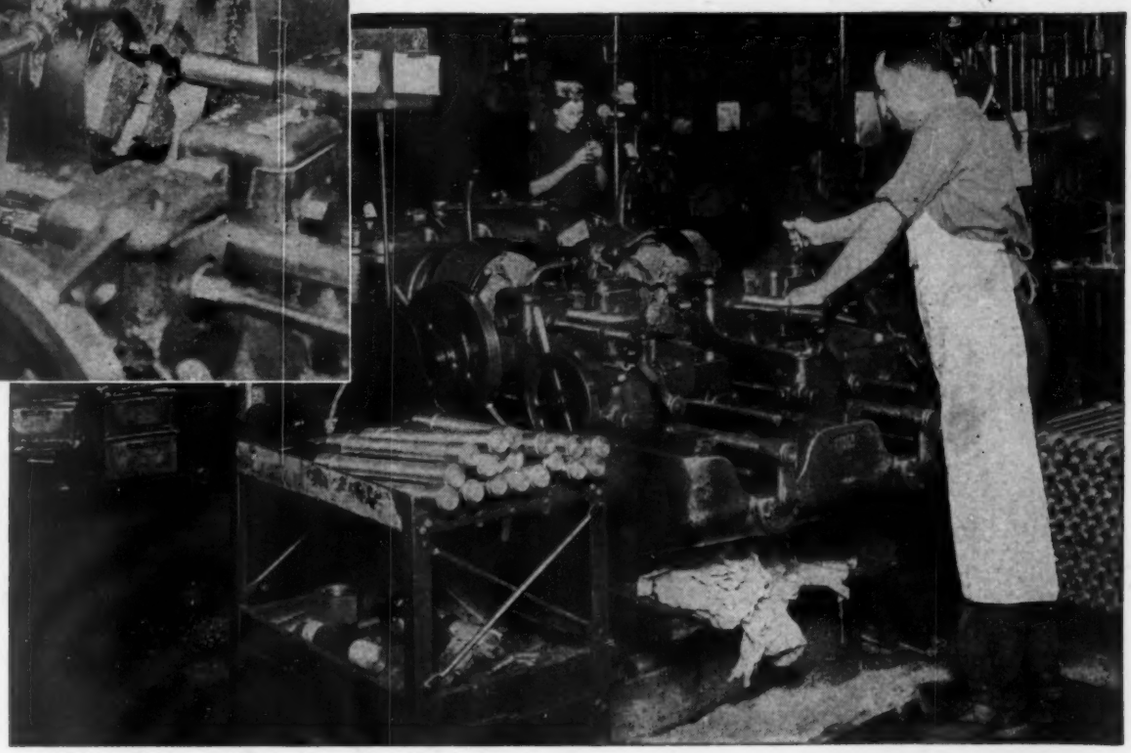
Cylinder Head Studs are a vital part of the Diesel Engine.

If the engine is to perform unfailingly—and it cannot fail—every part must function perfectly hour after hour, possibly for days or weeks.

The threads of the cylinder head studs—the vital link which literally holds the engine together—are held to extremely close tolerance specifications. The studs are made from alloy steel and present a difficult threading operation. Yet the manufacturers of these parts have little difficulty in producing entirely satisfactory results when employing the LANDMACO Threading Machine.

Perhaps the LANDMACO Threading Machine will expedite your difficult Threading Operations too.

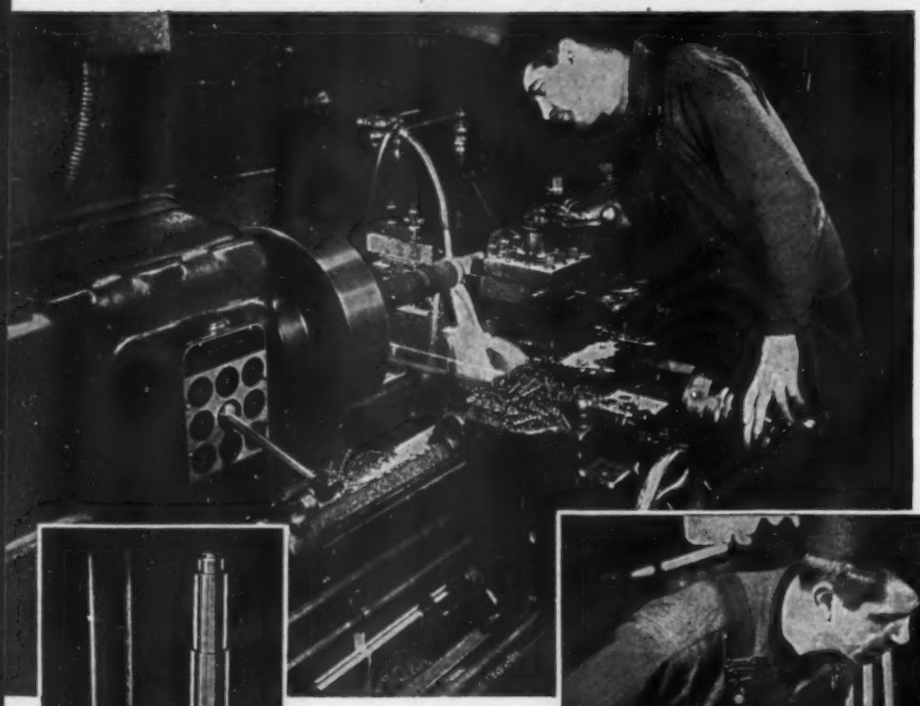




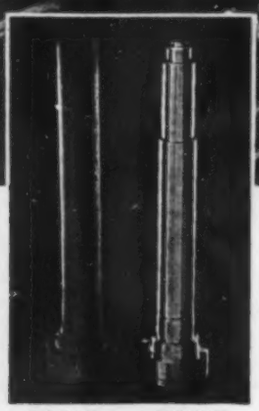
Write for Bulletin No. H-75

MACHINE CO. WAYNESBORO PENNA. U.S.A.

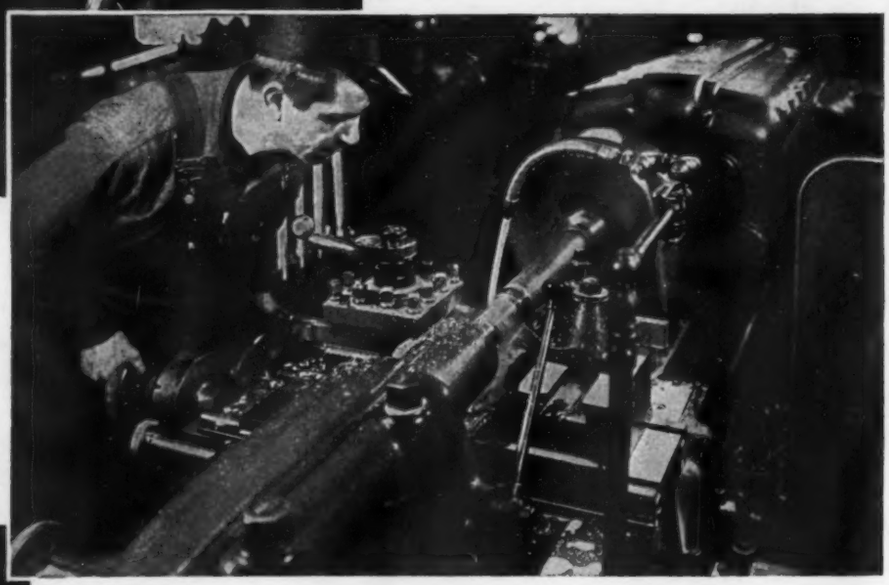
MINUTES INTO PROFITS...



20-In. "AMERICAN" Multi-Production Lathe, turning elevating pinion shafts from rough forgings for 40 M.M. anti-aircraft guns.



THIS to THIS in 18 minutes



This is no stunt! It's a steady production job day in and day out. Total floor to floor time, **18** minutes. Cutting speed, 175'. Feed, .015". Maximum depth of cut, 3/8". Material, S.A.E. 4640 steel—heat-treated.

PRODUCTION EQUIPMENT

Front and rear tool holders. Automatic length stops. Direct reading cross feed dials with indicating clips. Built-in roller bearing tailstock center. This is the kind of performance that transforms minutes into profits.

THE AMERICAN TOOL WORKS CO.

Cincinnati, Ohio, U. S. A.

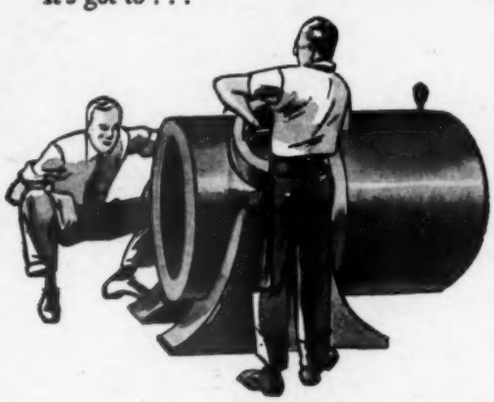
Lathes and Radial Drills

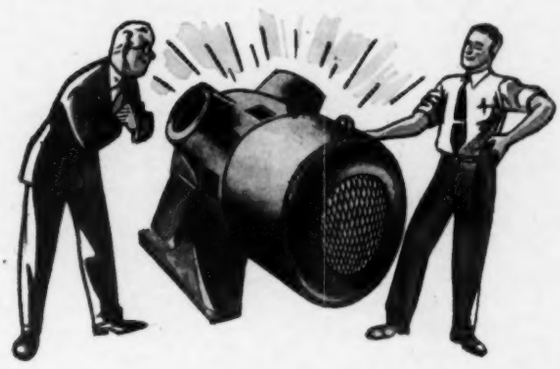
"So They Dumped an 1800 lb. Compressor in Our Lap!"

"It's Yours, Old Man," said the Sullivan Machinery Co. to the Allis-Chalmers engineer. "All that compressor needs to make it happy is a motor. But it's got to have the right qualifications before it can keep company with my machine!"

"I Don't Want This! Looks like the motors in San Francisco and the compressor's in New York. What I want is a motor that'll hug that compressor so close you can't tell where one starts and the other ends. It's got to . . ."

Well, That Compressor Manufacturer made our heads whirl. Lighter . . . more compact . . . simple design . . . rugged construction . . . trouble-free . . . these were only part of what he wanted. So we measured and figured and made designs . . .





We Cut Overall Size by pressing the rotor on the compressor shaft. That eliminated motor bearings and with it lubrication worries and any chance of misalignment. A new type of housing reduced weight, helped pack more hp into less space.

Result: A completely integrated package unit with a mighty saving in space. To install it you only had to connect the leads and it began to purr. Speaking of purring — you should have heard Mr. Compressor Builder when he saw the finished product.

A 1926

There's a Moral: Every time Allis-Chalmers engineering solves *special* motor problems, we discover new ways to build better standard motors for you. Watch for these new and better motors from A-C.

Wait 'til you see the NEW

ALLIS-CHALMERS MOTORS!

HEAR THE BOSTON SYMPHONY: *Every Saturday Evening, American Broadcasting Co.*

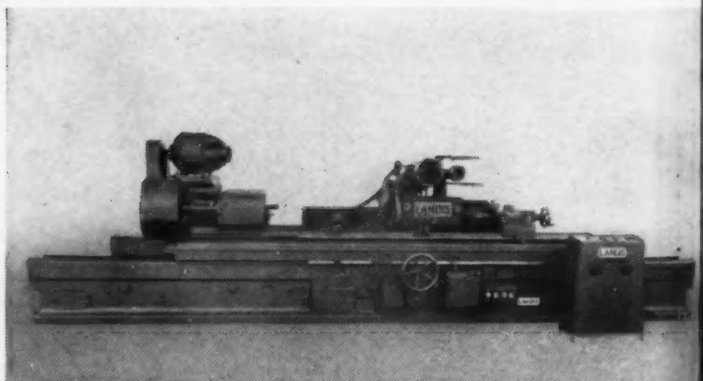
A LANDIS TOOL Grinder

Plain Hydraulic
Ball Race
Centerless
Tool Room
Roll
Hydraulic Universal
Centerless Thread

PLAIN HYDRAULIC 6" CH. For mass production of small parts such as bearings, small motor armatures, shafts and other parts of similar nature.

PLAIN HYDRAULIC 16" Type B. For grinding heavy work requiring a plain machine with 16" swing for lengths from 96" to 192". Printing cylinders, large lathe spindles, car axles, large shafts.

HYDRAULIC UNIVERSAL 10"x20" Type H. Flexible operation and close accuracy. Universal features—swivelling headstock and grinding wheelbase.



LANDIS TOOL *Precision Grinders*

LANDIS TOOL CO.

for Every Grinding Job

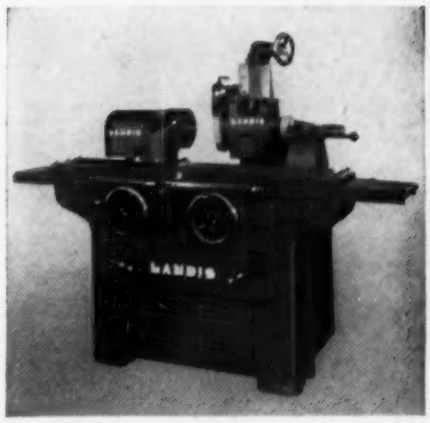
- Between Centers
- Centerless
- Taper
- Shoulder
- Tool Sharpening
- Centerless Thread
- Face
- Cylindrical

ENTERLESS GRINDER. For large production rough-feed grinding of cylindrical work and plunge grinding of tapers to extremely fine finishes.

PLAIN HYDRAULIC 4" Type H. For rapid accurate grinding of small parts up to 1½" in diameter in large or small quantities. Available for 12" and 18" work length.

The grinders illustrated are representative of more than 50 sizes and types of Landis Tool grinding machines. Whatever your grinding problem, Landis Tool engineers can help you solve it quickly and at lowest cost. The machines illustrated are typical of standard machines that are available. If your problem requires a specially engineered grinding solution, Landis Tool engineers are prepared to assist with modifications of a standard machine. Call on your local representative or write us direct.

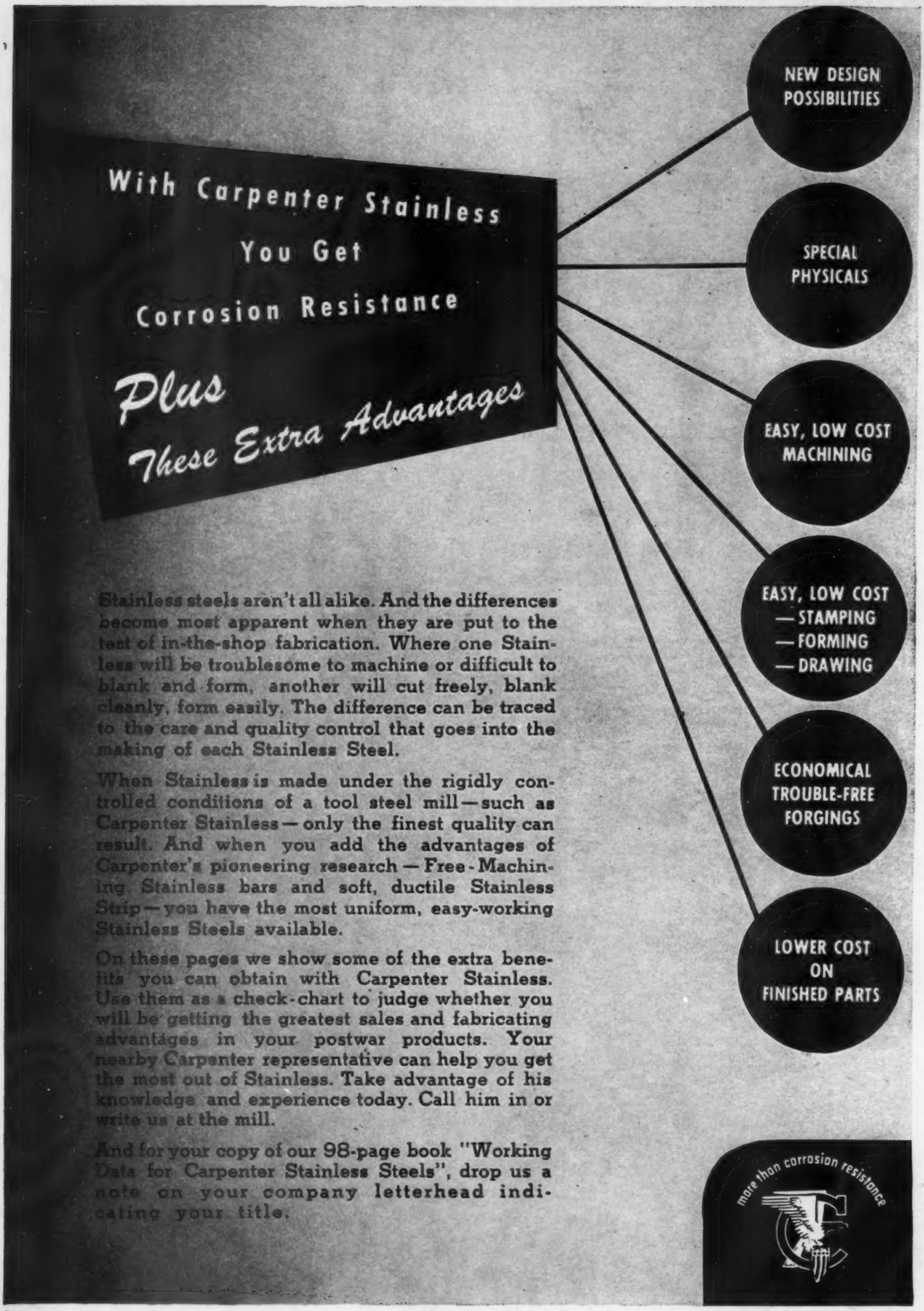
41



UNIVERSAL and TOOL 12" x 28". Flexible operation with swivelling headstock and wheelbase. For every grinding operation—cylindrical, internal, taper, surface, form tool and tool sharpening.

LANDIS TOOL Company

WAYNESBORO, PA.


With Carpenter Stainless
You Get
Corrosion Resistance
Plus
These Extra Advantages
NEW DESIGN POSSIBILITIES
SPECIAL PHYSICALS
EASY, LOW COST MACHINING
EASY, LOW COST — STAMPING — FORMING — DRAWING
ECONOMICAL TROUBLE-FREE FORGINGS
LOWER COST ON FINISHED PARTS
Stainless steels aren't all alike. And the differences become most apparent when they are put to the test of in-the-shop fabrication. Where one Stainless will be troublesome to machine or difficult to blank and form, another will cut freely, blank cleanly, form easily. The difference can be traced to the care and quality control that goes into the making of each Stainless Steel.
When Stainless is made under the rigidly controlled conditions of a tool steel mill—such as Carpenter Stainless—only the finest quality can result. And when you add the advantages of Carpenter's pioneering research—Free-Machining Stainless bars and soft, ductile Stainless Strip—you have the most uniform, easy-working Stainless Steels available.
On these pages we show some of the extra benefits you can obtain with Carpenter Stainless. Use them as a check-chart to judge whether you will be getting the greatest sales and fabricating advantages in your postwar products. Your nearby Carpenter representative can help you get the most out of Stainless. Take advantage of his knowledge and experience today. Call him in or write us at the mill.
And for your copy of our 98-page book "Working Data for Carpenter Stainless Steels", drop us a note on your company letterhead indicating your title.
more than corrosion resistance

LOW UNIT COST

When made from Carpenter Stainless No. 6 (Type 430), kitchen implements can be low priced yet more appealing.

EYE APPEAL

Eye-catching designs in sparkling Stainless! A light gauge of Carpenter Stainless No. 6 (Type 430). Strip was used here without sacrifice of strength and rigidity.

DESIGN FLEXIBILITY

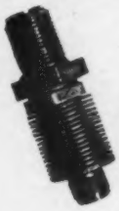
Lighter gauges and sharper radii are possible with this versatile metal as illustrated by these typical shapes of rolled molding.

HEAT RESISTANCE

Carpenter Stainless No. 4-TI (Type 321) or No. 4-CB (Type 347) used in the aircraft exhaust manifolds are examples of a wide range of Stainless grades that meet high temperature service requirements.

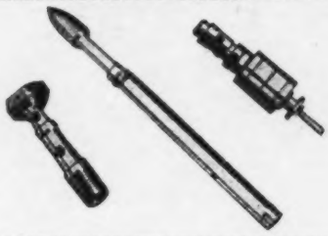
ELECTRICAL RESISTANCE

The uniform electrical resistance and easy-forming properties of Carpenter Stainless No. 1-JR (Type 406) are essential in this edge-wound resistor coil used in cargo ships.



AN EXCELLENT EXAMPLE

of the results obtainable with Free-Machining Stainless No. 5 (Type 416) can be seen in this finned aircraft spark plug.



EXTREMELY CLOSE TOLERANCES

Carpenter Free-Machining Stainless No. 8 (Type 303) met rigid machining requirements on these aircraft carburetor parts yet maintained the tremendous production volume necessary.

REJECTS CUT 50%

In one temperature control instrument Carpenter's soft and ductile Stainless Strip halved rejects on some 200 different parts.

Diameter—2 15/32"
Depth—3 3/16"

NO PROCESS ANNEALING

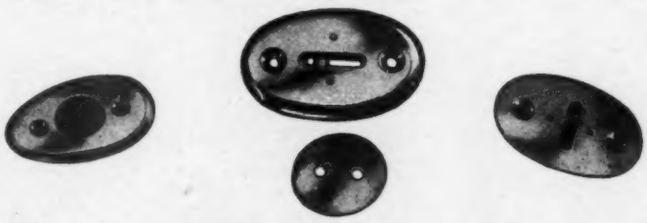
was needed to deep draw this steam trap bucket to a cup depth of 3½". Carpenter Stainless No. 4A (Type 304) used in 6¾" x .026" coils, kept rejects to a minimum, cut die wear and speeded output.

SOUND FORGINGS

This aircraft fuel supply valve body was easily forged from Carpenter Stainless No. 8 (Type 303). All Carpenter Stainless forging bars are rolled from machine-turned billets to assure flawless surfaces.

POSITIVE PROTECTION

against corrosion plus the required strength and hardness made Stainless a natural choice for these forged dental and surgical instruments. Clean, flawless Carpenter Stainless forging stock reduced rejects, increased output.



FINISHING COSTS CUT 28%

And that's typical of results obtained on these truss belt plates because a switch was made from a plated nonferrous metal to Carpenter Stainless No. 6 (Type 430). Strip with our famous ABC finish.

The Carpenter Steel Company • 109 W. Bern Street • Reading, Pa.

Carpenter STAINLESS STEELS

BRANCHES AT Chicago, Cincinnati, Cleveland, Detroit, Hartford, Indianapolis, New York, Philadelphia, Providence, St. Louis

For Each of Your Cut-off Jobs There's One Wheel that's Most Economical . . .

THERE are many kinds of cut-off jobs but for each one there's a Norton Wheel that's right — and a Norton abrasive engineer will be glad to help you select the right one for each of your jobs. Because he has the complete Norton line to choose from—over 50,000 possible specifications—he's not prejudiced in favor of some one special type of abrasive or bond. He will select from:

THREE ABRASIVES

For cutting all kinds of metal there's Alundum abrasive, with 57 Alundum abrasive available when an especially free cutting action is desired. For non-metallic materials there's Crystolon abrasive.

SEVERAL BONDS

Much of the success of a cut-off wheel depends on the choice of the correct bond for each job. The Norton engineer has a wide variety at his disposal—several types of resinoid bond, both natural and synthetic rubber bond and shellac bond.

NINE GRIT SIZES

The Norton engineer can use any one of the standard grit sizes but for cut-off wheels the usual range is from 16 to 100, or a combination thereof.

THIRTEEN GRADES

In grade, too, the Norton abrasive engineer has the full Norton range at his command but the selection of hardness will usually be between K and X, using the hardest grade that the job will allow.

MANY STRUCTURES

The patented Norton Controlled Structure process of manufacture enables the Norton engineer to select a cut-off wheel with the most effective grain spacing for the job.

ROUGH SIDES

Special rough-side wheels have been developed which give a remarkably free cutting action on certain non-metallic materials. By reducing the rubbing action on the sides of the wheel they minimize heat and discoloration.

Call in a Norton abrasive engineer today. Let him make a survey of all your cut-off jobs and give definite specifications for each one.

NORTON COMPANY, WORCESTER 6, MASS.

Distributors in All Principal Cities

W-1047

NORTON ABRASIVES

Snyder "Special" DOES A 3-OPERATION JOB ON ALUMINUM ALLOY PISTONS

Typical of many machines designed and built by Snyder for performing one or several operations in processing pistons is this "special" two-spindle automatic for counterboring, facing and centering aluminum alloy pistons.

The machine is a double-station set-up; each spindle is powered independently of the other and can be loaded and started separately if necessary. There are two slides provided with cutting tools, one set for roughing and one set for finishing.

The part is positioned and secured on a vertical stub spindle by means of a pin chuck. The work cycle consists of loading the part and pressing the clamp button which automatically positions and secures the part on the arbor through hydraulic action. When clamping is completed the spindle is started and the tools enter the work, cut to the required depth and automatically withdraw.

The accuracy of the cut and the conformity of the finish to specifications are maintained through the use of carbide tools. Electrical controls permit the machine to be operated successfully by average help.

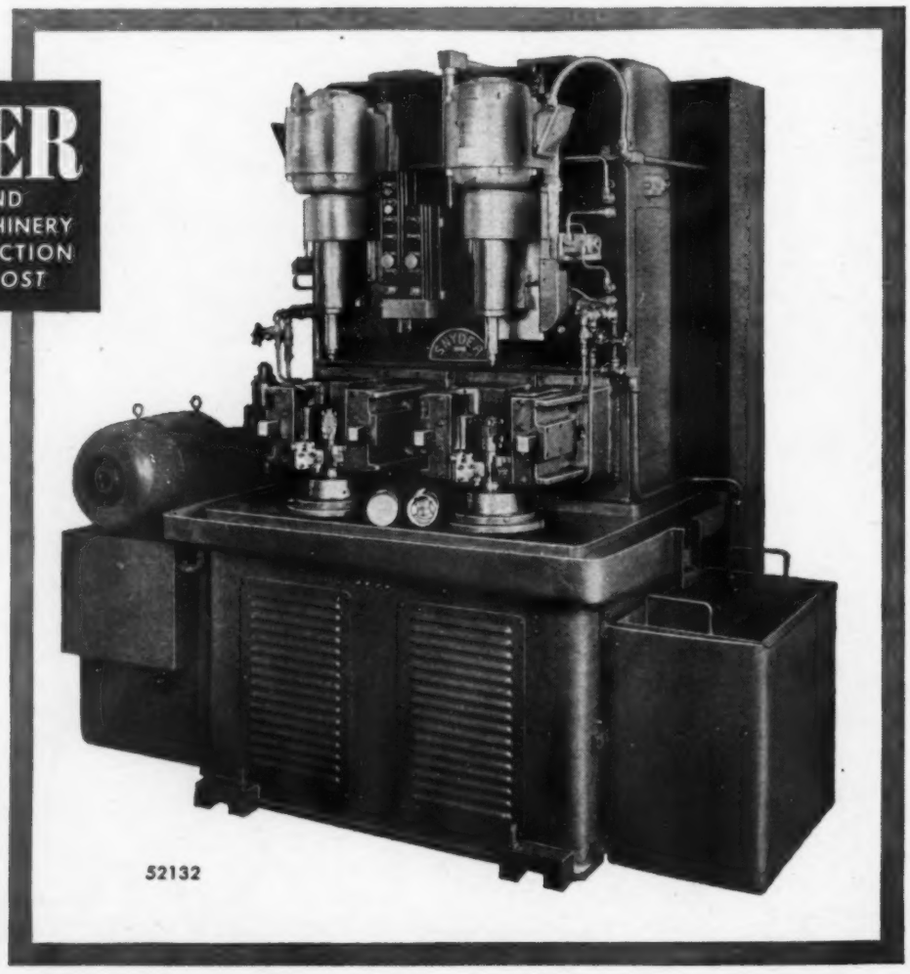
Machine base and column are welded steel and the base houses spindle drive motors and clamping mechanism. The hydraulic power unit is mounted to the left of the machine. Coolant tank and tray are at the right hand side.

Snyder "specials" are designed and built especially for the accomplishment of accuracy, safety and economy in all types of metal-cutting operations. They permit exact control of those factors which directly affect costs, volume and profits. If you have a metal-cutting problem, we invite your inquiry. *Snyder Tool & Engineering Company, 3400 E. Lafayette, Detroit 7, Michigan.*

SNYDER

DESIGNERS AND BUILDERS OF MACHINERY FOR HIGH PRODUCTION AT LOW UNIT COST

21 Years of Successful Cooperation with Leading American Industries



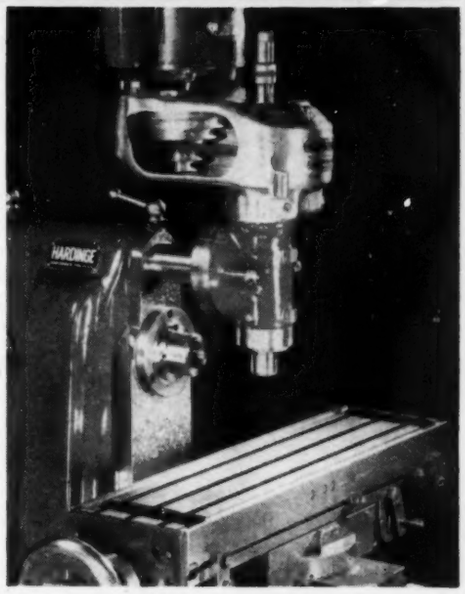
52132

HARDINGE
ELMIRA, N.Y.

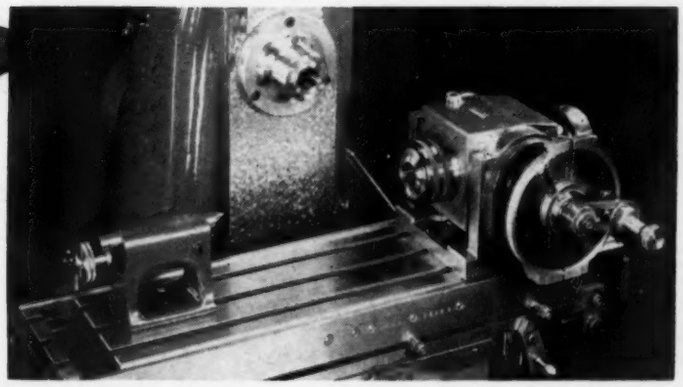
HIGH SPEED PRECISION MILLING MACHINE
FOR
TOOL ROOM AND LABORATORY

Tool room and laboratory work, because of the variety, demands useful milling machine attachments. Hardinge knows this. Illustrated are two attachments, in addition to the arbor and vise shown below. Other attachments are: Power feed for table; oil coolant facilities; 360° swivel base, also right angle base for dividing head; taper hole collets, as well as regular collets; step chucks and jaw chucks for dividing head.

Write for Bulletin TM-UM



This attachment provides high speed vertical milling. Has separate motor driven preloaded ball bearing spindle —eight selective speeds from 465 to 4250 r.p.m. — takes standard ½" capacity collets. Vertical head swivels to angular settings.



Modern design universal plain dividing head and tailstock. Designed to match the precision qualities of the machine. Features are: Preloaded ball bearing spindle; takes standard 1" capacity collets same as used in horizontal spindle; and high speed indexing, 4 to 1 ratio.

HARDINGE BROTHERS, INC., ELMIRA, N. Y.

"PERFORMANCE HAS ESTABLISHED LEADERSHIP FOR HARDINGE"

VERSATILE...

FOR A WIDE VARIETY OF PRECISION OPERATIONS

South Bend Precision Lathes offer special advantages to production shops, laboratories, and toolrooms that handle diversified work requiring a wide variety of exacting operations. They simplify change-over from one operation to another; help get new jobs into production quickly and economically. With their wide range of spindle speeds, they machine light metals, plastics, and steel with equal ease. A complete line of attachments and accessories enables South Bend Lathes to handle many operations which otherwise might require special fixtures or machinery. Take advantage of this versatility, coupled with South Bend precision, speed, ease of operation, and dependability, to increase the capacity and efficiency of your shop. South Bend Precision Lathes are made with 9", 10", 13", 14½", and 16" swings, collet capacities to 1", and bed lengths to 12'. Write for complete catalog.

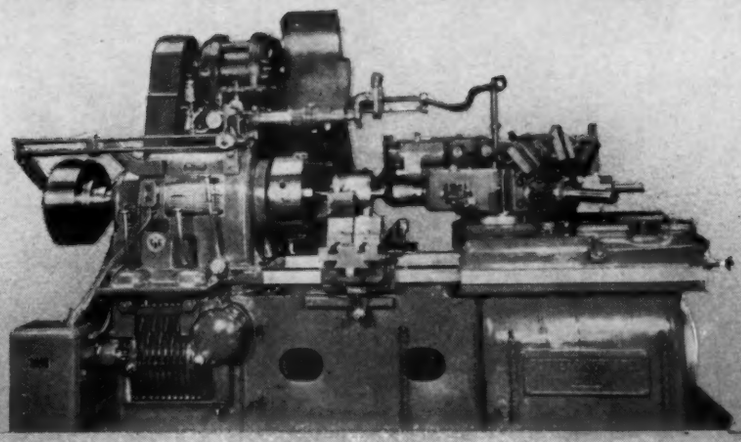
Write For FREE Catalog!

Catalog 100-D illustrates and describes all South Bend Precision Engine Lathes, Toolroom Lathes, and Turret Lathes, gives specifications, shows accessories and attachments. Size 11" x 8½", 68 pages, full color.

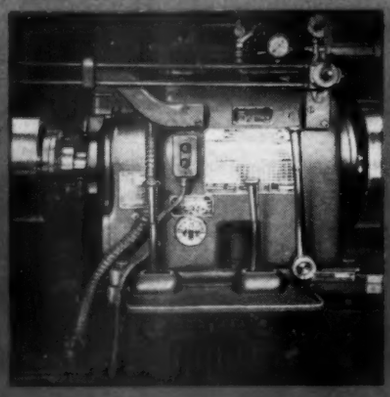
SOUTH BEND LATHE WORKS

419 EAST MADISON STREET • • SOUTH BEND 22, INDIANA

LATHE BUILDERS SINCE 1906



P&J 5-D POWERFLEX *Automatic Checking and Turning Machines*

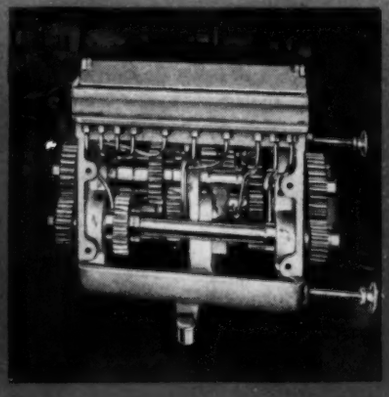


HEAD STOCK UNIT

Spindle of high carbon steel mounted on oversize Timken Tapered Roller Bearings. All headstock gearing of Chrome Nickel Steel; all shafts of alloy steel heat treated. Twenty changes of speed between 16 and 304 P.P.M., with speeds arranged in 5 sets of 4 automatic changes. Convenient pick off gears provide quick means of obtaining automatic changes.

AUTOMATIC SPEED AND FEED CHANGES

Power operated automatic clutches are provided under dog or hand control. All changes of speed and feed readily accomplished while under cutting load. As clutches are engaged and disengaged by power, dogs are subjected to no strain and simply select speed or feed required. An automatic spindle stop is provided.



FEED BOX UNIT

24 feeds are arranged in geometric progression from .007 to .165" or from .007 to .083" per spindle revolution. Feeds are arranged in 3 groups, namely coarse, medium and fine. Proper feed for each group is obtained by selection of pick off gears. Fast motion is driven directly and constantly from driving pulley.

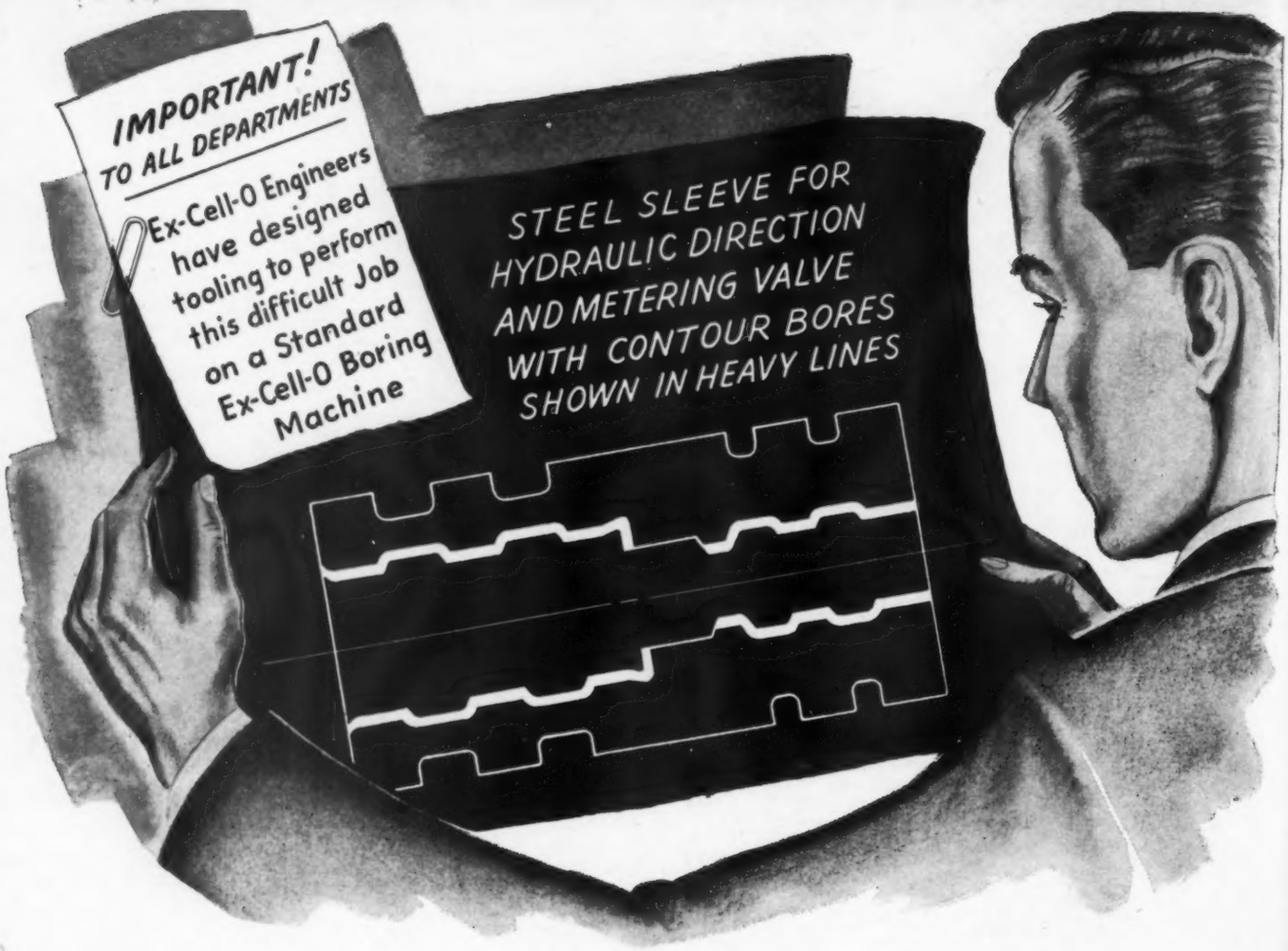
FEATURES DESIGNED TO ASSURE FLEXIBILITY AND HIGH PRODUCTIVITY

Buy those EXTRA VICTORY Bonds Now.

The features described and others incorporated in the P&J 5-D Power-Flex are covered in literature available on request.

For any work within its range, an output per spindle is available which assures high economy in the production of duplicate parts. Power, rigidity and convenience in operation are inherent in this machine. Tooling possibilities are almost unlimited. *Your investigation and your consultation with P&J engineers are invited.*

POTTER & JOHNSTON MACHINE CO.
PAWTUCKET, R. I.


IMPORTANT!
TO ALL DEPARTMENTS
Ex-Cell-O Engineers have designed tooling to perform this difficult Job on a Standard Ex-Cell-O Boring Machine
STEEL SLEEVE FOR HYDRAULIC DIRECTION AND METERING VALVE WITH CONTOUR BORES SHOWN IN HEAVY LINES

Gives You the Economy and Versatility of a Standard Machine With the Efficiency and Low Unit Cost of a Special

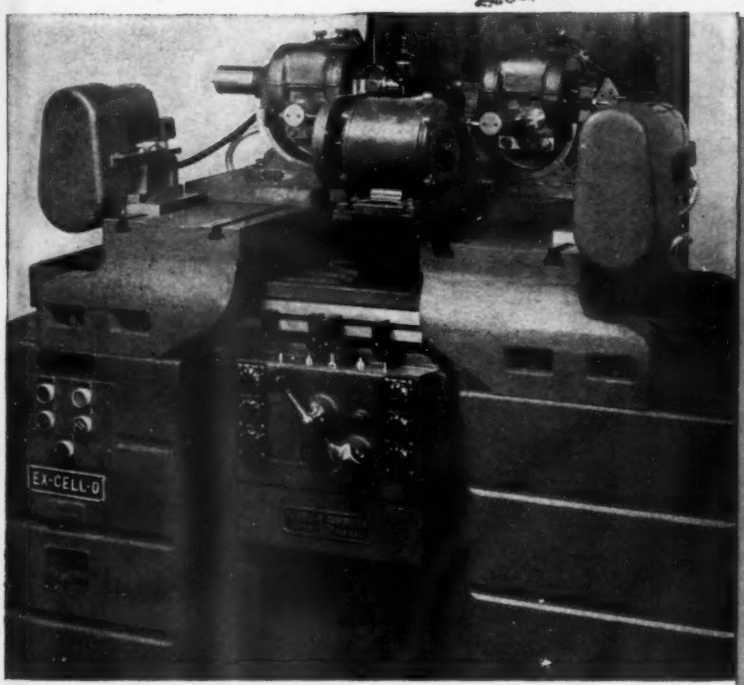
Stepped contour bores at both ends of a small steel sleeve for a hydraulic direction and metering valve were to be held concentric within .0002" and concentric with the O.D. within .0005". The problem was solved by using a standard Ex-Cell-O Precision Boring Machine with a specially designed collet which holds the part without distortion, and with two special contour boring devices.

These boring devices, adaptations of the Ex-Cell-O Universal Cam Type Dresser, were used to actuate the tools for the stepped contour bores at both ends within the prescribed limits. The simple machine cycle makes operation easy. The operator loads the part in the collet and shifts the start cycle lever. The collet drive starts; the machine table moves to the left hand boring position and stops. The contour boring device on the left bridge actuates the tool for the left hand boring cycle, then withdraws it. The machine table moves to the right end and stops. The right hand boring device actuates the tool for contour boring at the right end and then withdraws it from the work. The machine table returns to the central position and the work spindle stops so the part can be unloaded and another part loaded.

You may not have a problem exactly like this. Whatever it is, Ex-Cell-O engineers are glad to offer you their years of precision machining experience. Contact your nearest Ex-Cell-O representative today, or write direct to Ex-Cell-O at Detroit.

EX-CELL-O CORPORATION

Now YOU CAN DO STEPPED CONTOUR BORING ON A STANDARD EX-CELL-O BORING MACHINE



Above: The machine operation is extremely simple because the problems involved were solved by proper tooling. This standard Ex-Cell-O Style 1212-A Precision Boring Machine with special tooling was used for this unusual application.

Where increased production, high accuracy, and greater economy through multiple operations are required . . .
See EX-CELL-O First!

XLO
EX-CELL-O for PRECISION

- Standard and Special Multiple Way-Type Precision Boring Machines
- Continental Cutting Tools
- Precision Thread Grinding Machines
- Precision Lapping Machines
- Broaches and Broach Sharpening Machines
- Multiple Drilling and Other Special Purpose Machines
- Tool Grinders
- Hydraulic Power Units
- Grinding Spindles
- Drill Jig Bushings
- Aircraft and Miscellaneous Production Parts
- Fuel Injection Equipment
- R. R. Pins and Bushings
- Pure-Pak Paper Milk Bottle Machines

GET YOUR FREE COPY of this useful book. Illustrates and describes Ex-Cell-O's complete line of Precision Machine Tools, Cutting Tools, and facilities for parts production. Write for Ex-Cell-O Bulletin 27121.

DETROIT 6

46—17

The Practical Automatic for Long, Medium &

Now, with these new Warner & Swaseys you can apply the automatic principle *profitably* to small and medium lots, as well as long run production.

No cam changes are necessary and many other advantageous features have been included in the improved design:

Radically new shockless spindle indexing mechanism which insures holding closer accuracy.

Accelerated Geneva motion for more rapid spindle drum indexing.

Unusual tool clearance and chip area with automatic chip conveyor.

Micrometer Cross Slide Adjustment.

A range of 24 spindle speeds provided by 8 sets of pick-off gears — conveniently assembled, small and easy to handle.

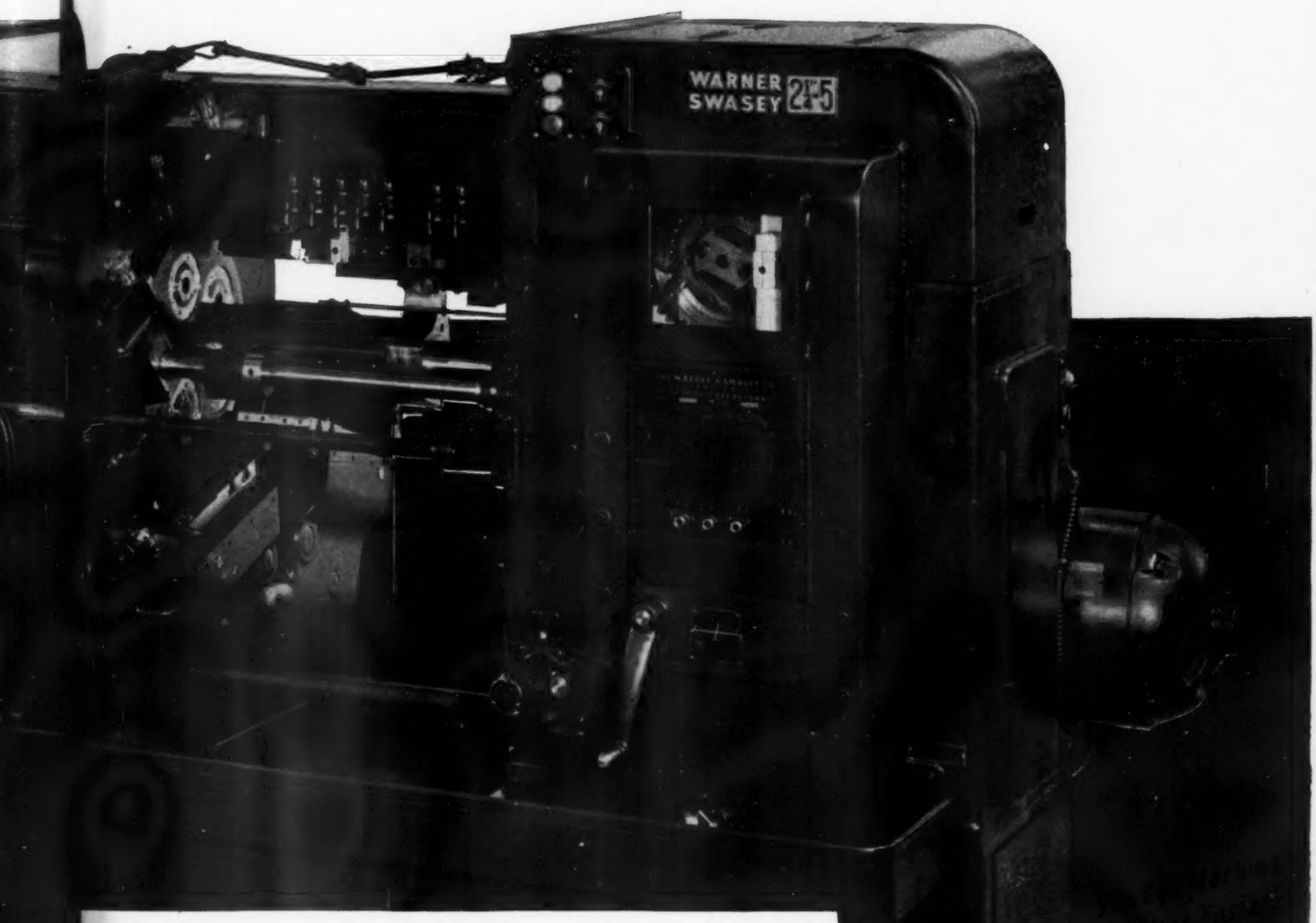
These are only a few of the innovations so timely in effecting higher speed, lower-cost production.

No tie-up of money in assorted stocks of cams • No cam storage space required • No in-and-out recording and tracing "lost" cams

The cams that control tool strokes are *permanently* assembled in a patented QUICK-SET mechanism that makes possible an infinite number of settings, by quick, simple adjustment on a graduated quadrant.

A NEW MULTIPLE SPINDLE

SHORT RUN PRODUCTION!



3 MODELS

5-Spindle Bar Machines
2 Sizes—1¾" and 2¼" Bar Capacity

5-Spindle Chucking Machine
6" Swing

★

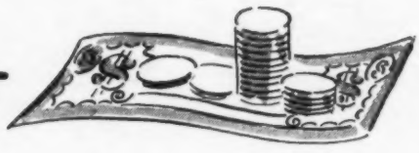
You should have full information on these new machine tools with their many cost-cutting features and design improvements.

Get in touch with your nearest Warner & Swasey Field Engineer for full particulars, or—send today for descriptive bulletins, just printed.

TURRET LATHES—MULTIPLE-SPINDLE AUTOMATICS—PRECISION TAPPING AND THREADING MACHINES

AUTOMATIC by

WARNER & SWASEY
Machine Tools
Cleveland

Trade this for this ; save and 

No more *forcing* of sheaves. Simple wrench operates Allis-Chalmers' "Magic-Grip" — *fastest mounting and demounting sheave on the market.* Saves time, money.

SEE HOW QUICKLY, EASILY THIS NEW SHEAVE MOUNTS AND DEMOUNTS

1 Place sheave on shaft. Slides on smoothly because clearance is provided by expanded bushing. There's *no* hammering — *no* forcing! Complete sheave and bushing unit comes intact—ready for quick, easy mounting.

2 Align exactly, using straightedge, (It's easy with this free-sliding sheave.) Then tighten three cap-screws; sheave is locked to shaft, *grips like magic!* No set screws to damage the shaft. Write A-C for Bulletin B6310.

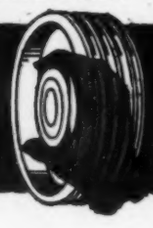
RECONVERTING?

GET THIS NEW FREE KIT!

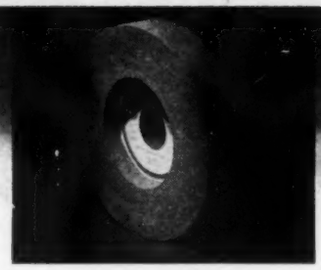
To help you find out how your present equipment will fit into future production, A-C offers a new free "Reconversion Inventory Kit" — Fact Sheets and Check Lists to speed your appraisal of V-belt drives, electric motors, and centrifugal pumps. Applies to all makes. Call your A-C distributor or district office, or write Dept. 00, ALLIS-CHALMERS MFG., Milwaukee 1, Wisconsin.

A 1855

Allis-Chalmers Texrope

"MAGIC-GRIP"  **SHEAVES**

Proven QUALITY



Proven quality and dependability of performance are hallmarks of the products of the Mid-West Abrasive Company.

Mid-West's outstanding successful tool room grinding wheel, and every other product of the broad Mid-West line—honing stones, sharpening stones, coated abrasives, disks and wheel dressers—all must bear these two hallmarks.

Let engineered quality and dependability guide you in your choice of abrasives, and we feel certain that choice will be Mid-West. Prompt delivery on all items.

MID-WEST ABRASIVE CO.

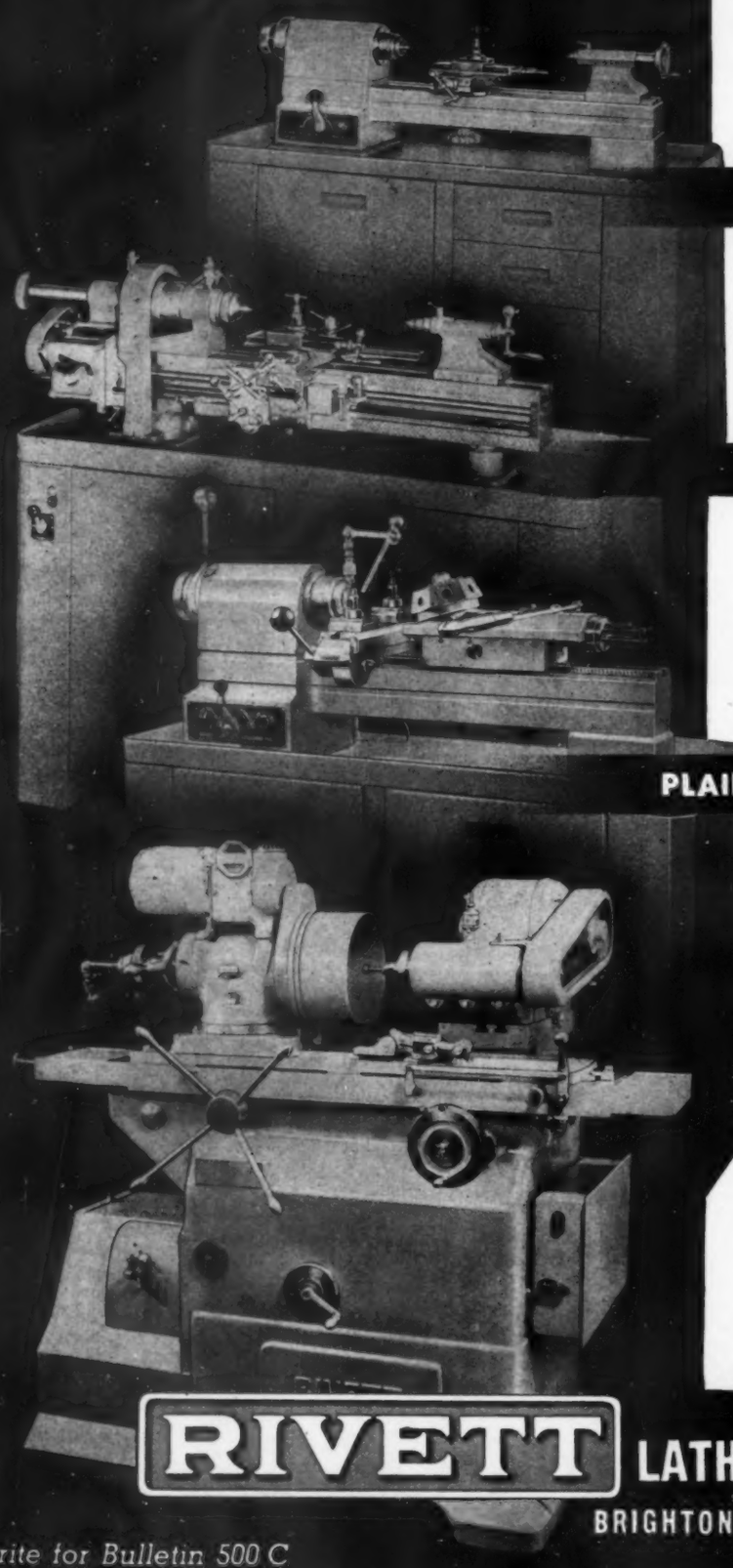
Manufacturers of DEPENDABLE Abrasives

Owosso, Mich. • Detroit • Rochester, Pa.

KNOWN THE WORLD OVER

RIVETT

MACHINE TOOLS



PLAIN CABINET LATHES

An engineered unit, quick to set up, with power, wide speed range, and vibrationless performance; capable of many jobs often produced on heavy, costly, machines. No. 715: swing: 7" dia.; center distance: 15"; collet cap.: ¾" max.: No. 918: swing 9" dia.; center distance: 18"; collet cap.: 1" max.

TOOL ROOM LATHES

No. 608 back-geared, screw cutting, precision lathe for production of fine work. It will handle a great variety of parts in minimum time. Finely made attachments for milling, spiral cutting, slotting, relieving, taper and ball turning, grinding, forming, and multiple operations are available. Swing 8½" dia.; center distance 18¼"; collet cap.: 1" max.

PLAIN CABINET TURRET LATHES

No. 918 an efficient producer on small duplicate parts. In combination with six turret operations, double tool cross slide can be furnished for straight and taper turning, forming or cutting-off. Swing: 9" dia.; collet cap.: 1" max.

INTERNAL GRINDERS

Primarily for tool room work requiring wide variety of operations. Attachment for external grinding. Fine table feed with micrometer stop for shoulder and face grinding. In two sizes: No. 112, grinding cap. up to 8" dia.; table travel up to 8". No. 104, grinding cap. up to 3" dia.; table travel up to 4".

ARMY E NAVY

RIVETT LATHE & GRINDER INC.

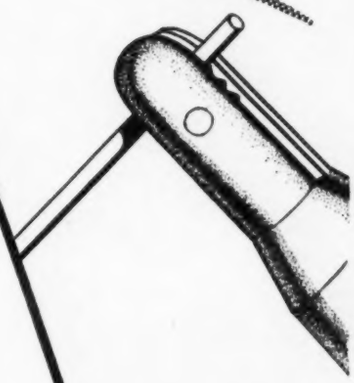
BRIGHTON, BOSTON, MASS., U.S.A.

Write for Bulletin 500 C

PAGE *Welding* ELECTRODES

HELP YOU TO KEEP WELDING COSTS

DOWN



• Type and cost of current used—welding position—fit-up—efficiency of the operator—all these affect the over-all cost of production welding. Quite as important as any of these are the type, size and make of electrode used. And that's where PAGE comes in. Here's why.

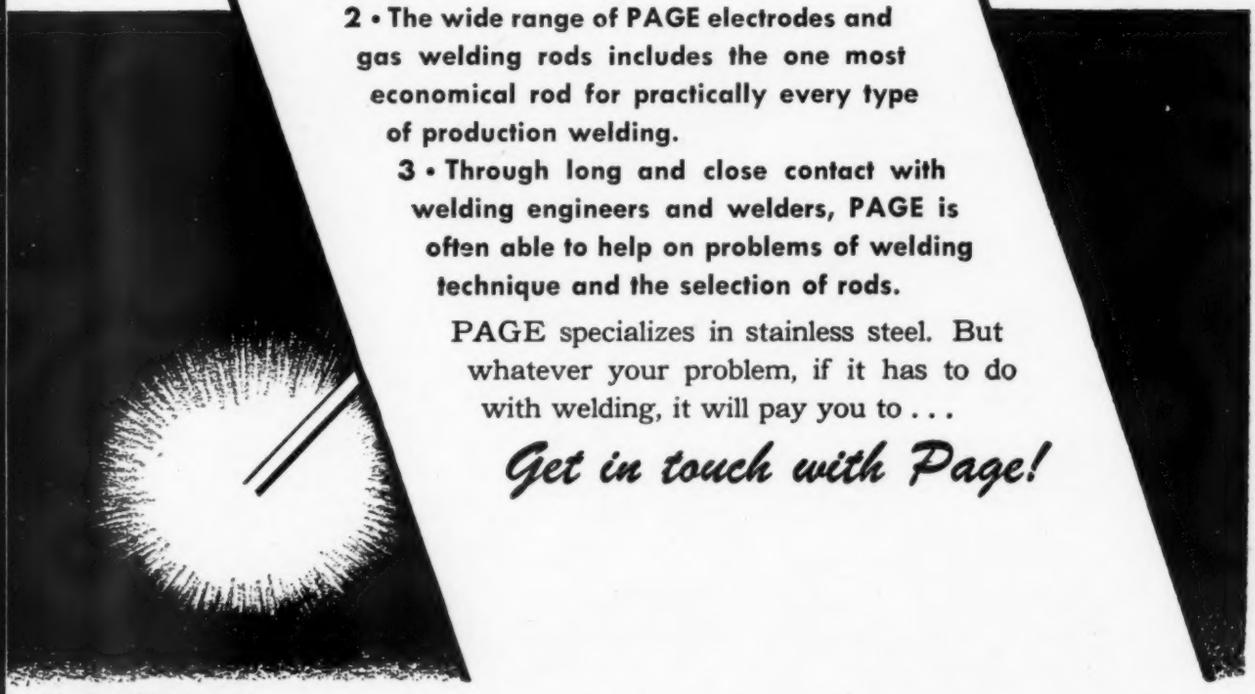
1 • PAGE electrodes are of uniformly high quality. Experienced welders take that for granted.

2 • The wide range of PAGE electrodes and gas welding rods includes the one most economical rod for practically every type of production welding.

3 • Through long and close contact with welding engineers and welders, PAGE is often able to help on problems of welding technique and the selection of rods.

PAGE specializes in stainless steel. But whatever your problem, if it has to do with welding, it will pay you to . . .

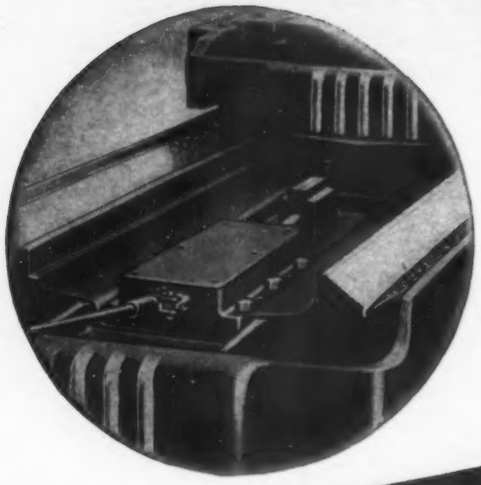
Get in touch with Page!



ACCO Monessen, Pa., Atlanta, Chicago, Denver, Detroit, Los Angeles, New York, Pittsburgh, Portland, San Francisco, Bridgeport, Conn.

ACCO TRADE MARK

PAGE STEEL AND WIRE DIVISION
AMERICAN CHAIN & CABLE



Designed for greater safety at higher speeds

It is now possible to obtain a positive hydraulic safety stop and jack to completely protect anything around the machine in case of complete failure of the electrical control.

This safety stop is designed to stop the table quickly in case of control failure with a uniform decelerated motion without severe shock to parts of the Planer. All parts are completely enclosed to protect them from dirt and chips so there is no chance of failure.

This stop also is used as a jack for relocating the table over the bull wheel by inserting a handle in the stop and pumping the table back to its running position. No crane or other means, therefore, is required for this operation which invariably results in damage to the gear teeth.

After the stop is used it automatically resets itself. The operator or maintenance department does not have to replace any parts or reset any mechanism, thereby saving time and eliminating the human element.

HYPRO PLANER
Positive Hydraulic TABLE STOP

THE CINCINNATI HYPRO PLANER COMPANY

PLANERS · BORING MILLS · PLANER-TYPE MILLERS

CINCINNATI, OHIO

5 WAYS MAN-AU-TROL INCREASES VERTICAL TURRET LATHE PRODUCTION

Without losing any of its versatility of manual operation, the Bullard MAN-AU-TROL Vertical Turret Lathe . . . in automatic operation . . . steps up output for 5 reasons.

1. It is cutting almost continuously . . . no stops for measuring the piece or changing feeds and speeds.

2. It is set up for maximum productivity . . . assuring continuous operation at maximum practical feeds and speeds.

3. The machine eliminates the elements of fatigue and human error.

4. Its turret head permits standard simplified multiple tooling for simultaneous cutting not possible with other types of Vertical Turret Lathes.

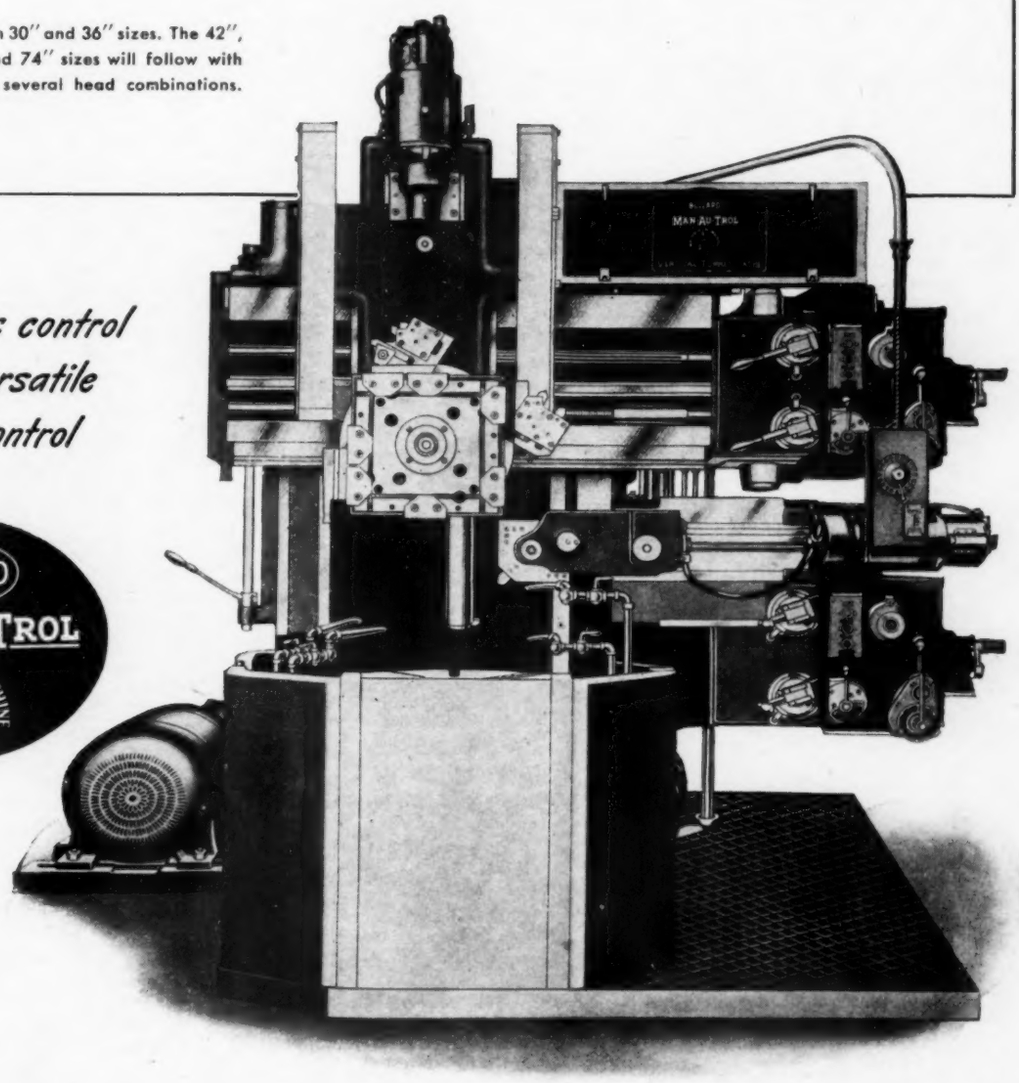
5. It consistently works to a degree of accuracy not obtainable with manually-operated machines . . . work spoilage practically eliminated.

For full details about the unique productivity, flexibility and accuracy of Bullard MAN-AU-TROL Vertical Turret Lathes, write for your free copy of Bulletin MAV-G-1 today. The Bullard Company, Bridgeport 2, Connecticut.

Now made in 30" and 36" sizes. The 42", 54", 64" and 74" sizes will follow with selection of several head combinations.

The automatic control that is as versatile as manual control

BULLARD
MAN-AU-TROL
MASTER OF THE MACHINE



BULLARD CREATES *NEW METHODS* TO MAKE MACHINES DO MORE

EIGHT HOURS! TO SEASON GREEN CASTINGS

The ELECTRO BUMPER which will season castings up to 100 tons has been proven in actual tests in various plants.

WITH NEW

ELECTRO BUMPER

Ready for Production in 8 Hours

NO HEAT TREATING!

NO AGING!

The Electro Bumper needs no attention—plugged in at night—casting seasoned by morning.

USED FOR CASTINGS OF STEEL, IRON AND ALLOYS OF BOTH

•

The method of procedure is easy—just suspend rough machined casting from above by chain or rope. Casting is bumped 20 to 30 bumps per minute which vibrates casting—thus settling molecules of metal. The casting, when finish machined, will not change its shape.

This method will not change tensile strength, elastic limits, or other physical characteristics of the casting, but produces a better casting, in a few hours, than the old method of heat treating and months of aging.

Write today or send blue prints of your castings. Our Engineers will be able to give you the correct answer to your casting seasoning problems.

ATLANTIC TOOL & DIE WORKS

19024 FLORIDA AVE. (at Gratiot near 12 Mile Road) ROSEVILLE, MICHIGAN (Detroit Suburb)

DAVIS BORING TOOLS

The Davis Boring Tool Division of Larkin Packer Co., Inc., is now a division of the Giddings & Lewis Machine Tool Company. This union marks a progressive step in modern industrial manufacturing service.

Davis boring tools have for years maintained a high standard of quality and performance on all boring applications. It is fitting that the Giddings & Lewis Machine Tool Company, a pioneer and leader in the machine tool industry, should carry on the progressive work of the Davis engineers. The G. & L. organization will continue the development of boring tools to effectively meet your manufacturing requirements.

Present and future users of standard and special boring tools and equipment will materially benefit from the combined experience of these two major organizations in the metal working field. It is your assurance that modern tools will be developed continuously for your specific needs—the equipment you use—and your individual boring problem.

DAVIS BORING TOOLS

DAVIS BORING TOOL DIVISION of
GIDDINGS & LEWIS MACHINE TOOL CO., FOND DU LAC, WIS., U. S. A.

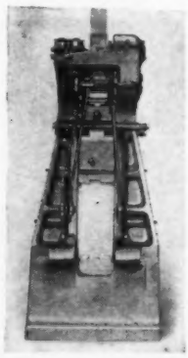
The Multi-Cutter Boring Tools that produce more at less cost

Better Drop Forgings

from Model J-2 CHAMBERSBURG Board Drop Hammer

Drop forgings to fill the demands of today's industries must be closely matched, more easily jiggable and more true to die than those made on outmoded hammers. Competitive conditions give the advantage to parts that require less machining, that need less metal removal.

Carefully checked records of the performance of Chambersburg Board Drop Hammers indicate that the more effectively guided heavier frames, with improved facilities for maintaining alignment, result in a greater degree of precision over a longer period of time. Fewer adjustments are needed and they can be made more quickly.



Rear of Hammer showing Simplicity of Design.

Chambersburg Board Drop Hammers represent the up-to-the-minute, carefully considered essence of experience gained during nearly half-a-century of concentrated and continuous effort in the building of impact machinery.

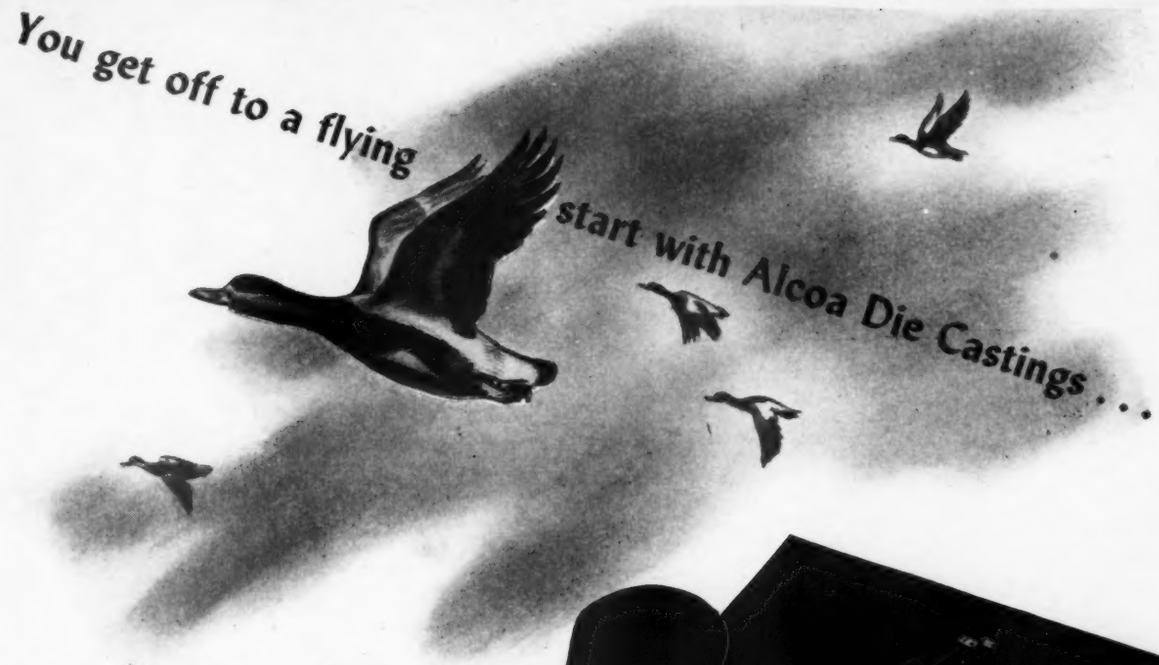
Write for a copy of Bulletin 252-2

CHAMBERSBURG ENGINEERING CO., CHAMBERSBURG, PA.

ARMY E NAVY

CHAMBERSBURG

HAMMERS · CECOSTAMPS · PRESSES



Die-cast parts need comparatively little finishing to get them ready for assembly

Little excess metal is needed with Alcoa die castings. Parts run uniform and dimensions are accurate. Details are reproduced faithfully. Relatively little machining and finishing work are required, before parts are ready for assembly.

You save on machining time, when you start with Alcoa die castings. Your costs are correspondingly low.

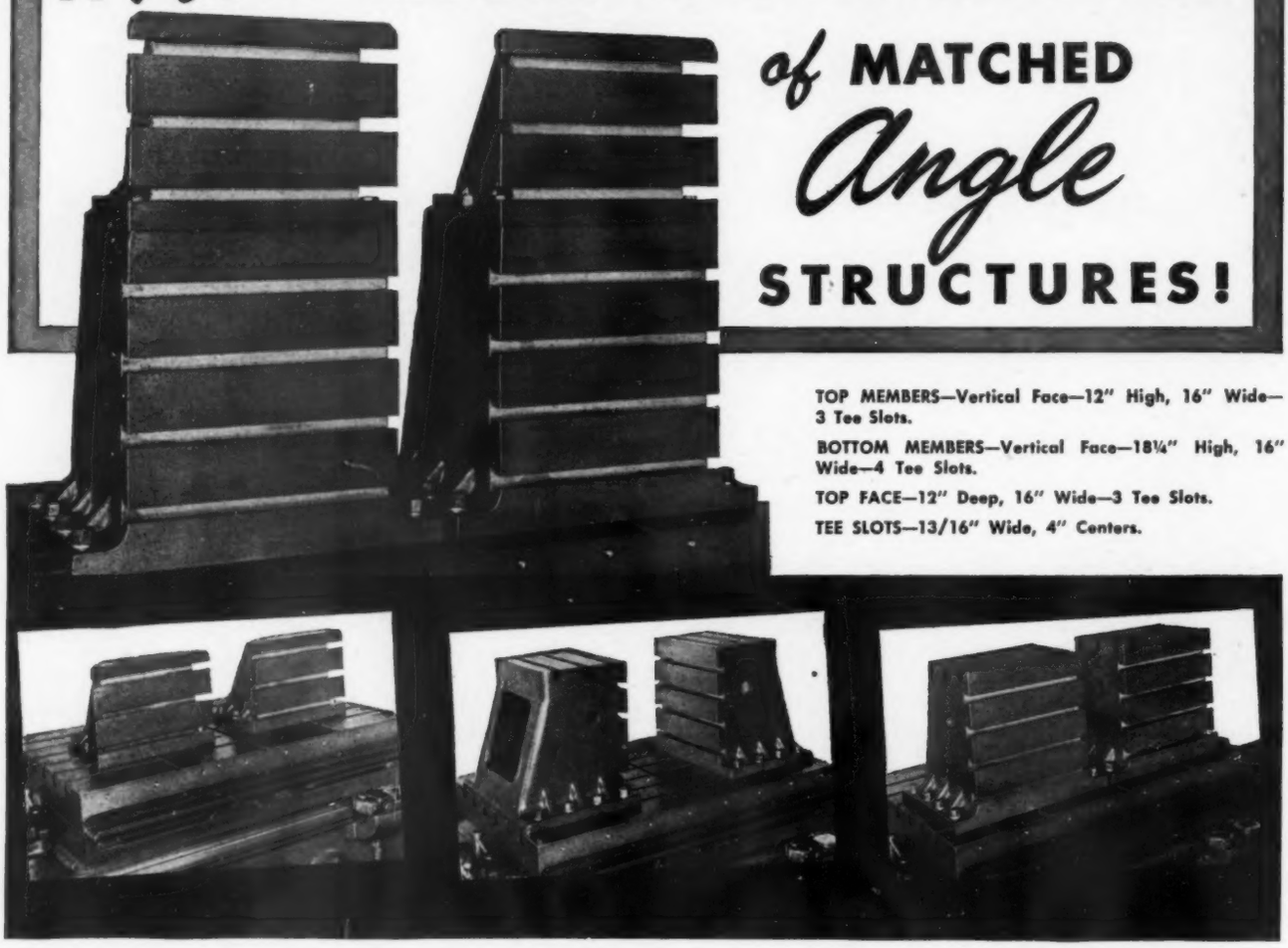
To obtain fullest benefits with die castings, it's well for the parts designer to discuss his problem with an Alcoa die casting specialist. This co-operative effort usually improves the product and simplifies production. Alcoa engineers are at your service.
ALUMINUM COMPANY OF AMERICA,
2107 Gulf Bldg., Pittsburgh 19, Pa.

FIRST IN ALUMINUM

ALCOA

ALCOA
ALUMINUM

A *New* HIGH IN A COMBINATION of MATCHED *Angle* STRUCTURES!



TOP MEMBERS—Vertical Face—12" High, 16" Wide—3 Tee Slots.

BOTTOM MEMBERS—Vertical Face—18¼" High, 16" Wide—4 Tee Slots.

TOP FACE—12" Deep, 16" Wide—3 Tee Slots.

TEE SLOTS—13/16" Wide, 4" Centers.

THIS combination of matched units serves convenience and rigidity for accurately locating and chucking work when boring, milling, planing or for other toolroom and general use. They can be used singly or in variety of combinations for large or small work.

They are machined from box section castings, with Tee slots and flat surfaces in precise alignment.

They are made with the same tooling and quality as the JIGMIL table.

Each set includes Tee slot nuts, studs and screws.

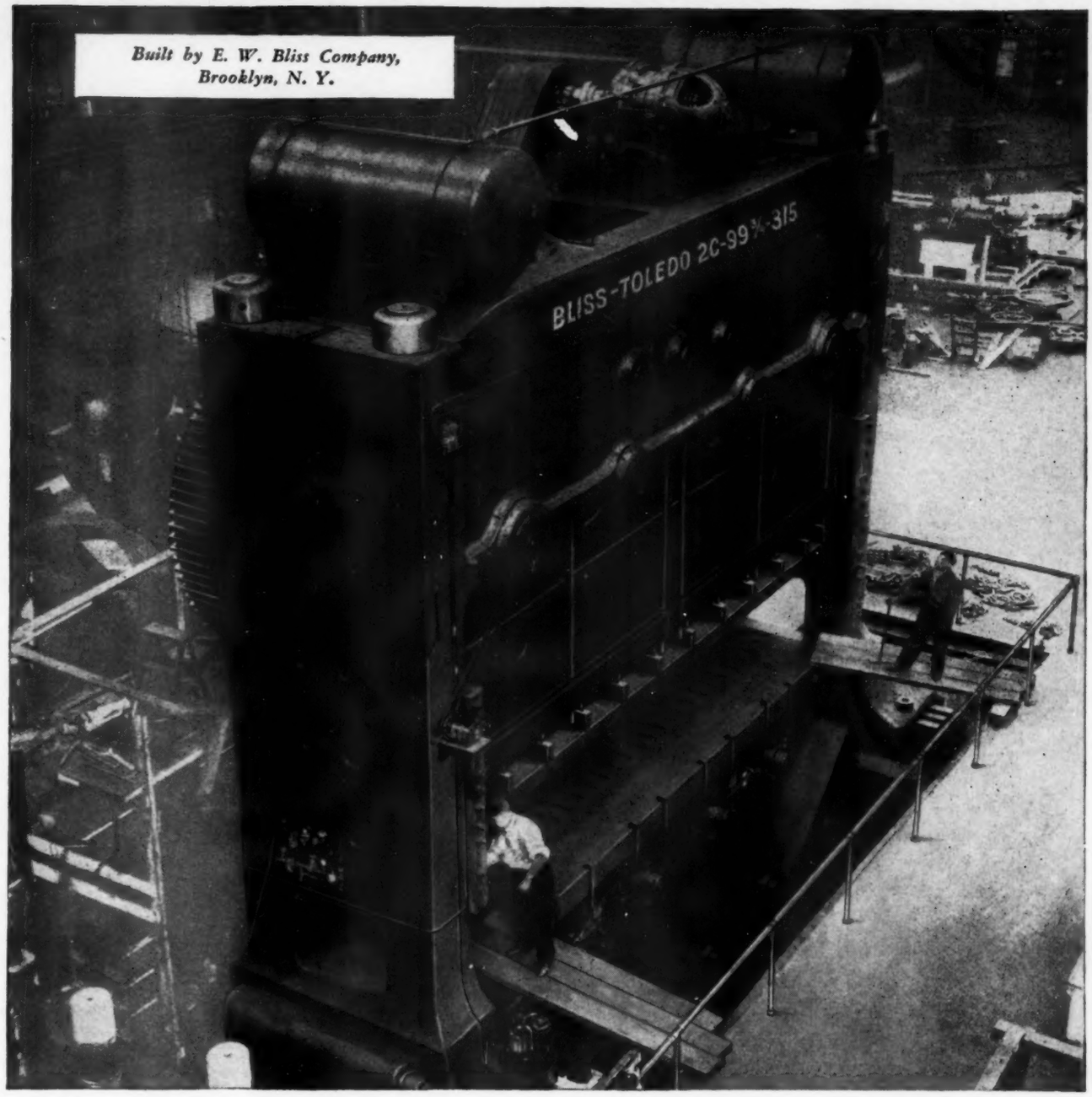
Write for price and delivery!

★

World's finest boring and milling machine

★

DeVLIEG MACHINE COMPANY DEVLIEG JIGMIL **450 FAIR AVE. FERNDALE 20, (Detroit) MICH.**



Built by E. W. Bliss Company, Brooklyn, N. Y.

2,500 TONS AT A STROKE!

With TIMKEN BEARINGS Carrying the Power!

This Bliss-Toledo single action, straight side, mechanical press is one of the largest ever built. It weighs 1,150,000 pounds and can exert a pressure of 2,500 tons at the end of the stroke.

The press was designed primarily to blank out chassis frames and produces two frames every ten seconds, operating at 6 strokes per minute.

To help make its work easier and more accurate; to increase its endurance; and decrease maintenance; Timken Tapered Roller Bearings are applied on the drive shaft and flywheel, clutch and brake, where they eliminate friction, prevent wear, carry radial, thrust and combined loads and hold shafts and gears in correct and constant alignment.

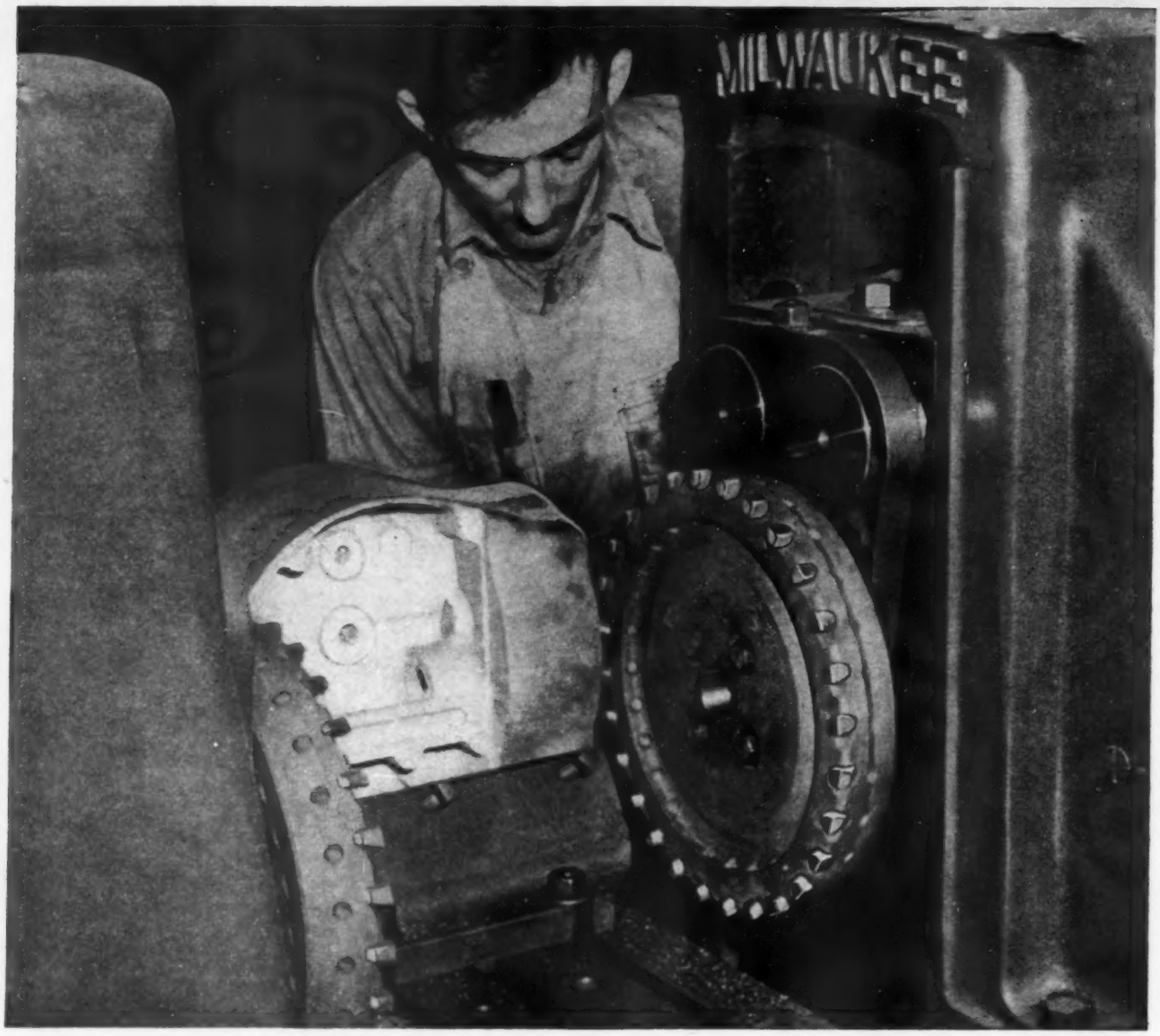
This big press was built for the Russian Government and already has been shipped. It will be used in connection with the Russian reconversion and rehabilitation program. The Timken Roller Bearing Company, Canton 6, Ohio.

P.S. No matter what kind of equipment you are building, it will pay you to make sure the trade-mark "TIMKEN" is stamped on every bearing you use.

TIMKEN

TRADE-MARK REG. U. S. PAT. OFF.

TAPERED ROLLER BEARINGS



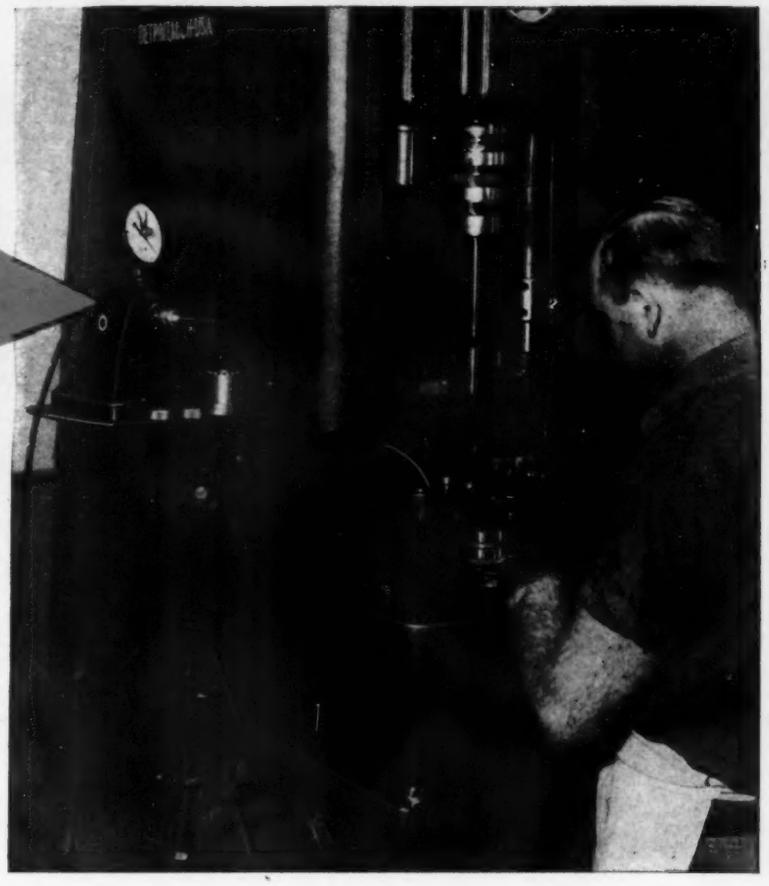
LOVEJOY TYPE "A" FACE MILLING CUTTERS FOR *Medium Duty*

Tool popularity goes with ability to produce consistently—easily—accurately. This, plus positive-locking blades, has made the Lovejoy Type "A" face mill a favorite in production plants and tool rooms requiring *medium duty* cuts. All blades are *positive-locked* in the forged steel housings at the correct cutting angles. This eliminates breaking stresses, and gives exceptionally free cutting qualities. Lovejoy blades of HSS, tungsten carbide, and cast alloy are interchangeable over a wide range of sizes. Shell end, Type "A" cutters are available for National Standard and Lovejoy Standard arbors, and the Type "A" can be supplied for any spindle mounting. For full information, prices, and specifications on the Type "A" and all other Lovejoy milling cutters, boring heads, boring bars, etc., write for Catalog No. 27.

LOVEJOY TOOL COMPANY, Inc., Springfield, Vt.

CONTROL STATION

on the PRECISION-PRODUCTION LINE



The AIR-O-LIMIT Gage Works Right at the Machine

The Pratt & Whitney AIR-O-LIMIT Internal Comparator will work wherever there is a handy air connection—at the bench, in a gaging room—*or right at the machine.*

Often, it is desirable to establish a control station at the machine. Here, the operator can check any part quickly and accurately as it comes off the machine. This serves to reduce spoilage at the source, and to speed up the flow of accurate production. Your operator knows beyond question that his work is accurate . . . he can check whenever he wishes.

Air-O-Limit Comparators are available to do a dozen gaging jobs. They will check for I.D. or O.D. limits, roundness, taper and bellmouth, giving instant, accurate readings that split "tenths."

They employ a simple principle—a spindle with two tiny opposite nozzles through which compressed air is forced. The amount of back pressure caused by limiting the discharge of air through the nozzles is registered on a precision pressure indicator calibrated in ten-thousandths of an inch.

Put air to work in your production gaging. Get the facts on how Air-O-Limit Comparators can speed up inspection, control accuracy on the job and reduce production costs. Ask for complete literature.

PRATT & WHITNEY

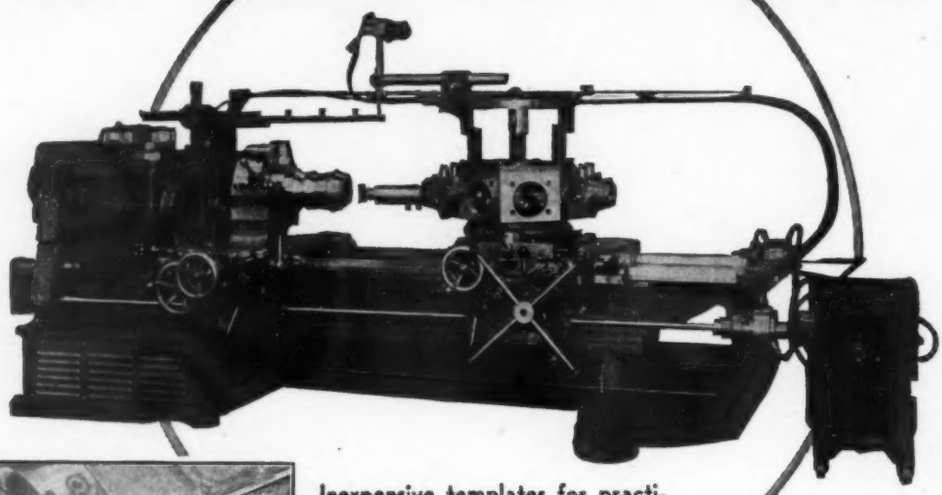
Division Niles-Bement-Pond Company

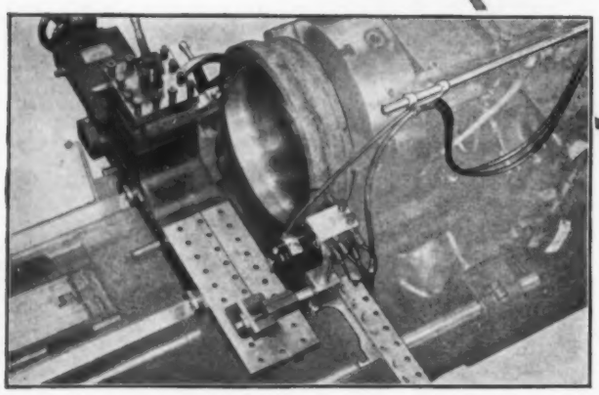
WEST HARTFORD 1, CONNECTICUT

NO SHAPES TOO DIFFICULT

when you do

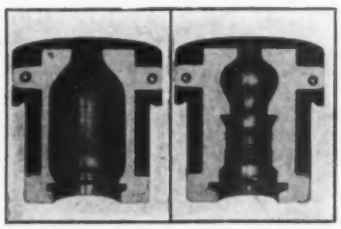
LOW COST DUPLICATING WITH THE ACME-DUPLIMATIC





Inexpensive templates for practically any class of work is all that is required for the different jobs.

This is a new development in low cost contour turning and boring for Plastic, Glass and Rubber molds; all types of Dies.



Through the means of a push button station the duplicating equipment can be disengaged and the machine is then ready for standard turret lathe work.

If you are interested in lowering the cost on your present methods for this type production, we can help you. It's a subject for our Engineers, so send us your problems. No obligation, of course.

The ACME MACHINE TOOL Co.
CINCINNATI 32, OHIO

The CONE AUTOMATIC MACHINE COMPANY

sees many

GOOD THINGS AHEAD

It is reported that . . . . . .

The National Advisory Committee for Aeronautics proposes to release to schools, libraries and industries over 300 technical reports hitherto secret.

get ready with CONE for tomorrow

Lycoming is experimenting with two new aircraft engines: a 36-cylinder, 5,500 lb. radial developing 5,000 h.p., and a 12-cylinder, 2,100 h.p., weighing only 1,445 lbs.

get ready with CONE for tomorrow

Monsanto Chemical Co. has a plastic armor plate that has shattered machine gun bullets in tests.

get ready with CONE for tomorrow

Curtiss-Wright is working on an "uninhabited" airplane capable of 1,400 miles per hour.

get ready with CONE for tomorrow

Firestone is making a heavy-duty tire with a wire carcass for off-the-road trucking.

get ready with CONE for tomorrow

A new distillery, the largest of its kind in the Western Hemisphere, will be built in Maine to make alcohol from Aroostook County potatoes.

get ready with CONE for tomorrow

Shell Oil Company has a new combustion head for gun-type domestic burners that will cut fuel consumption 20% and is suitable for use on burners now in operation.

get ready with CONE for tomorrow

Eastman Kodak promises that any reasonably well equipped amateur will soon be able to make his own color transparencies and prints.

get ready with CONE for tomorrow

Jack and Heintz will manufacture the Skinner gasoline engine. This is a double-opposed "pancake" type, made largely of aluminum with a compression ratio of 8 to 1 and a weight of less than 2 lbs. per h.p.

Mellon Institute has found, after thorough testing, that solid magnesium alloys do not burn.

get ready with CONE for tomorrow

The Weather Bureau has begun a survey of the country's wind resources in anticipation of the use of wind power for generating electricity.

get ready with CONE for tomorrow

A new kind of glass made by American Optical Company transmits 90% of visible light rays, but only 10% of heat rays.

get ready with CONE for tomorrow

Fifteen years of research have led to a form of porcelain enamel, made by C. Hommel Co. of Pittsburgh, that is so thin as to be practically chipless.

National Carbon Company has a new oil made with a secret non-petroleum base, called "Prestone Motor Oil" that shows very little change in viscosity from 30° below zero to operating temperature.

get ready with CONE for tomorrow

Illinois Central and Edison General Appliance Co. have collaborated on the first all-electric dining car, scheduled to go into service early in 1946. The car has its own diesel generating plant which supplies all facilities for cooking, freezing, dish washing, garbage disposal and air conditioning.

get ready with CONE for tomorrow

The Celotex Corporation has patented a process for making building planks out of excelsior and Portland cement.

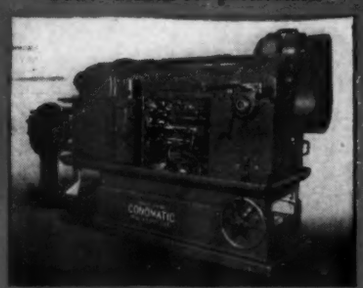
get ready with CONE for tomorrow

Another substitute for natural paint brush bristle is made of casein and was developed by the Eastern Regional Laboratory of the U. S. Department of Agriculture.

3 of these diameters are eccentric

This washing machine part, made of B-1112, is machined from round stock on a 1⅝" 8-Spindle Conomatic in 10 seconds. Three of its five diameters are eccentric to .018".

Write to Cone for particulars.



Ask your CONE representative to show you our new color motion picture

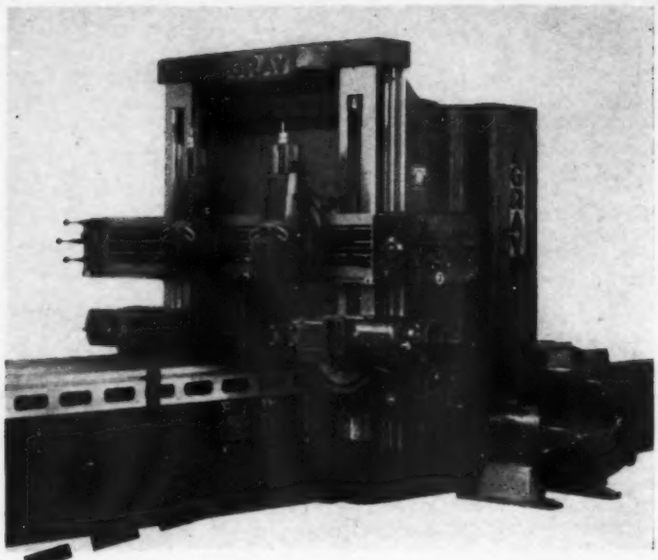
CONE

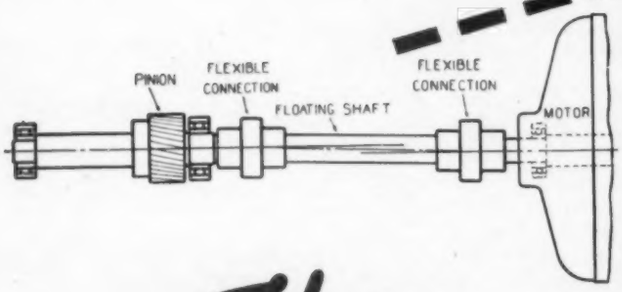
AUTOMATIC MACHINE CO., INC. ★ WINDSOR, VERMONT, U.S.A.

26

GRAY *Advantages*

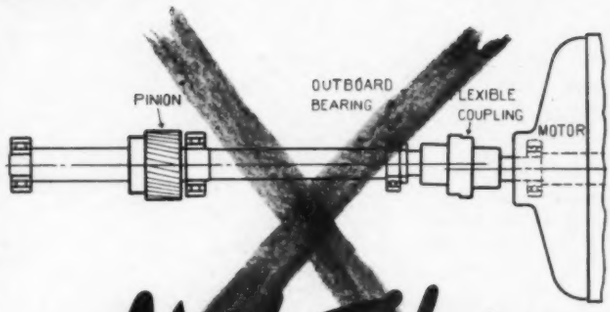
THE FLOATING SHAFT DRIVE





This

The Gray floating shaft has been designed with flexible connections in place of the usual flexible coupling (see drawings). This system relieves the bearings of the strain caused when the motor, under the stress of heavy operation, gets out of line with the planer shaft. Note that bearing A on the right hand drawing is eliminated.



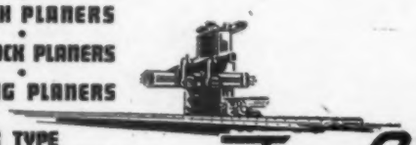
Not This

Note the strain (flexible coupling) imposed on bearings when shafts are not in alignment. This strain results from wear, vibration, noise and backlash, all of which contribute to inefficiency of operation.

The above comparisons illustrate the advantage of the Gray floating shaft drive over the old type of conventional flexible coupling. You will note that the motor drives the gear train through a floating shaft, thus eliminating strain and wear on the bearings as well as the multitude of coupling troubles that are bound to result from misalignment of motor and planer drive shafts. It obviously also eliminates vibration due to misalignment of motors.

Our Engineering Department feels that this is an important feature and would welcome any inquiries relative to more specific information.

DOUBLE HOUSING and OPENSIDE PLANERS
•
SWITCH PLANERS
•
DIE BLOCK PLANERS
•
MILLING PLANERS
•
PLANER TYPE MILLING MACHINES
•
HORIZONTAL BORING MACHINES



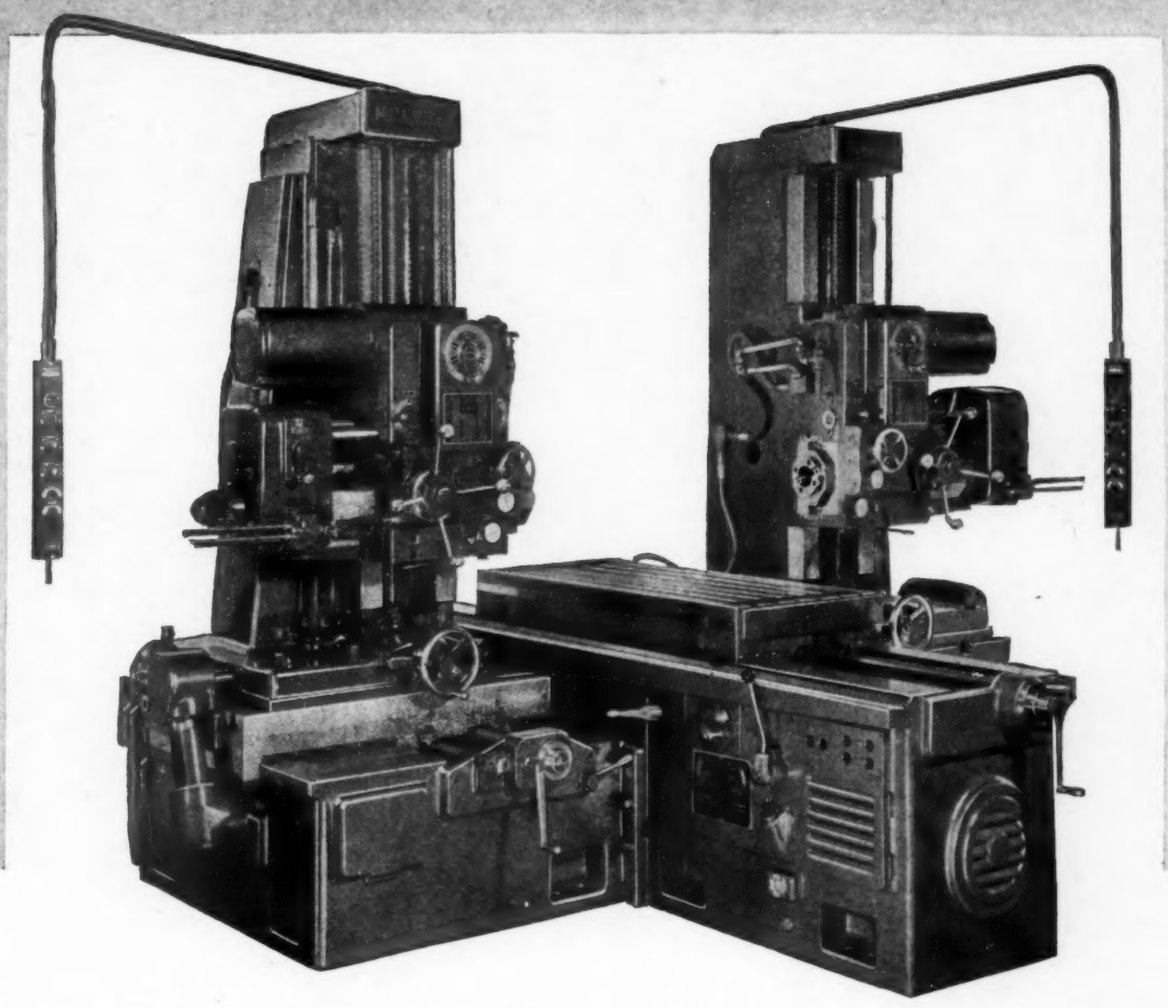
Sold in Canada by Upton, Bradeen and James, Ltd. Sold in Latin America by Machine Affiliates.

The G.A. **GRAY** *Co.*

CINCINNATI 7, OHIO, U. S. A.

Announcing the **KEARNEY & TRECKER**
Milwaukee

Model TT Precision Milling and Boring Machine



Scientifically constructed for accurate and convenient operation, the Model TT Precision Milling and Boring Machine enables the operator to mill and bore a workpiece from two sides without changing the setup — an answer to your difficult milling and boring problems that require exceptional precision. Convenient operation is of paramount importance on any machine tool. This machine provides dual table controls on each side of the bed. Each upright is a complete unit in itself with column and spindle controls. A swiveling control pendant provides complete control from the most advantageous operating position at each column.

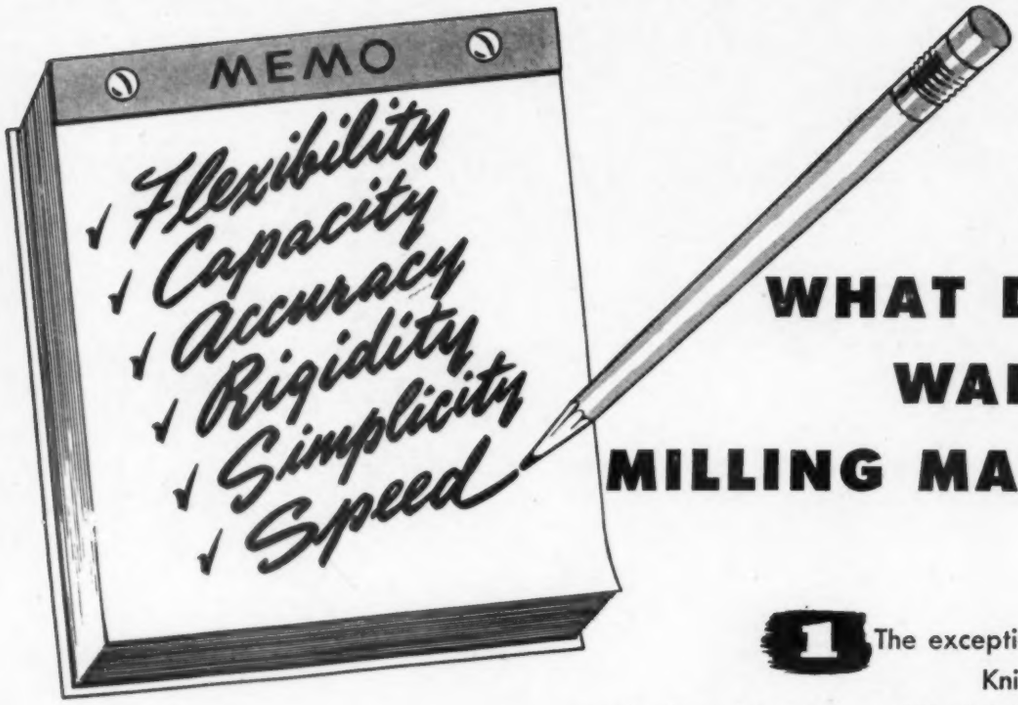
Features of operation and construction that make this machine outstanding in precision operation and versatility are —

- The No. 50 National Standard spindle nose to accommodate modern milling tools.
- Spindle rotation of both spindles in either direction permit the use of right or left hand milling cutters.
- A wide range of speeds and feeds are available for the efficient use of modern cutting tools on a wide variety of operations.
- A thread cutting feature provides boring and thread cutting on two sides of a workpiece in a single setup.

Write for Catalog T11, a complete descriptive catalog on the Model T and the Model TT Precision Milling and Boring Machine.

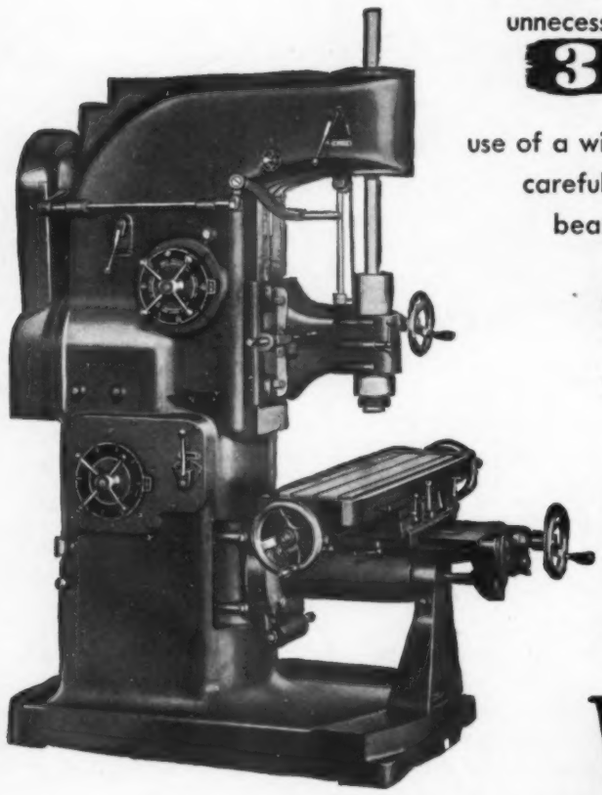
BUILDERS OF MILWAUKEE ROTARY HEAD MILLING MACHINE • MIDGETMILL • SPEEDMILL • FACE MILL GRINDER • AUTOMETRIC BORING MACHINES

Kearney & Trecker
Products
CORPORATION
MILWAUKEE 14, WISCONSIN
Subsidiary of Kearney & Trecker Corporation



WHAT DO YOU WANT IN A MILLING MACHINE?

1 The exceptional adaptability of Knight Millers simplifies production of unusual or difficult jobs that often require two or more special machines... **2** Its tilting, swiveling table makes expensive special jigs, angle plates or other fixtures unnecessary for complicated milling, boring or shaping jobs... **3** Its sixteen table and spindle feed changes, and four different vertical spindle feeds, provide for the use of a wide range of various size cutters... **4** Its strong, carefully engineered one-piece column casting, wide accurate bearings, precision gearing and rigid supports promise accuracy, effortless operation and long service... **5** Its easy operating controls for direction, speeds and feeds, properly located for full vision and convenience, save time and boosts production.



Knight Millers combine ALL the benefits of versatility, accuracy, speed, simplicity and long service. Learn how they can help you increase output and lower costs.

Write for Catalog Today!

W. B. KNIGHT

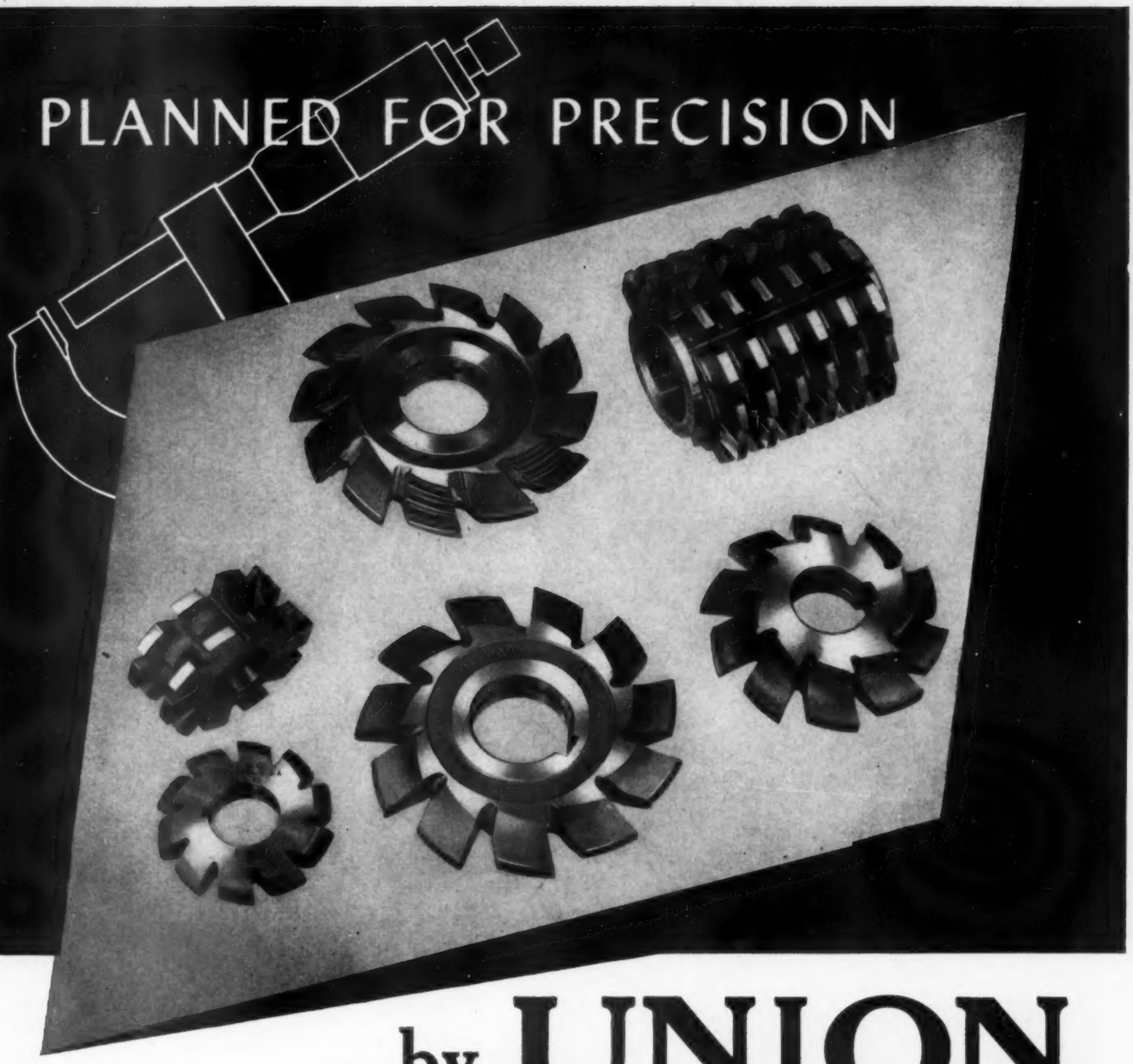
MACHINERY COMPANY

KNIGHT VERSATILE MILLERS ACCURATE RIGID

MORE GOODS for MORE PEOPLE at LOWER COST

3920 WEST PINE BLVD. • ST. LOUIS 8, MISSOURI

PLANNED FOR PRECISION



...by UNION

Any job which requires high precision also requires careful preliminary planning. Union has helped with an important part of your planning . . . by designing tools which will produce the precision results you want—under production pressure.

UNION TWIST DRILL CO., ATHOL, MASS.

STORES:

New York: 61 Reade St.
Chicago: 11 So. Clinton St.
Detroit: 5527 Woodward Ave.
San Francisco: 121 Second St.
Los Angeles: 524 E. Fourth St.
Seattle: 568 First Ave., South

UNION ★ BUTTERFIELD ★ CARD Divisions of the Union Twist Drill Company

S. W. Card Mfg. Co. Div.—Mansfield, Mass.
Butterfield Div., Derby Line, Vt.
Butterfield Div., Rock Island, Quebec

REAMERS by Butterfield

Illustrated: Straight and Spiral Fluted Hand Reamers, Straight and Spiral Fluted Chucking Reamers, Straight and Spiral Fluted Expansion Reamers, Lok-Tite Expansion Chucking Reamers.

Butterfield assures you of dependable efficiency and the most rigid standards of accuracy — your guarantee of high-quality, trouble-free performances in heavy duty reaming operations.

Butterfield Division

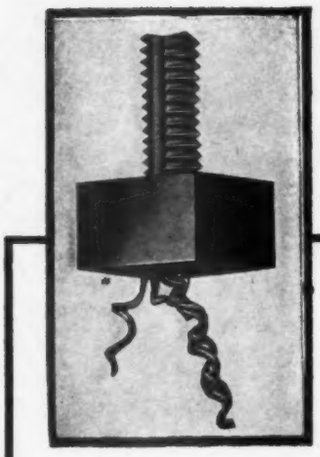
Derby Line, Vt. Rock Island, Que.

STORES: New York, 61 Reade St.—Chicago, 11 So. Clinton St.—Cleveland, Hal. W. Reynolds, 3346 Superior Ave.—Detroit, 5527 Woodward Ave.—Los Angeles, 524 E. Fourth St.—Toronto, 137 Wellington St., West—Montreal, 111 St. Paul St., West—Winnipeg, 403 Travellers Bldg.—Vancouver, 327 Shelly Bldg. Agents for Great Britain: Charles Churchill & Co., Ltd., 27-34 Walnut Tree Walk, Kennington, London, S.E. 11, England. Branches at Birmingham, Manchester, Glasgow, Newcastle-on-Tyne and Bristol.

UNION ★ BUTTERFIELD ★ CARD

CARD

HAND TAPS



FORCING THE CHIPS *ahead* OF THE TAP . . .

Above is a detailed view of chip-action produced by Card Spiral Pointed Hand Taps. Long, curling chips are forced ahead of the Tap – avoiding clogging – increasing strength of Tap – reducing breakage.

S. W. CARD MFG. CO.
Mansfield, Mass.

Divisions of the Union Twist Drill Company

LESS FATIGUE! MORE POWER! LONGER LIFE!

You get all THREE WITH CLECO RIVETERS

Photo courtesy of The Clark Grave Vault Company, Columbus, Ohio, shows Cleco No. 60AO Riveter and Cleco Holder-on currently at work on locomotive syphons.

● First, Cleco Riveters are easier to operate because the tubular air-thrown valve insures smooth action, while vibration and recoil are reduced by the plunger cushion in the valve block. Note the 3 handle styles shown, all well fitted to the hand, and free of lugs, etc.

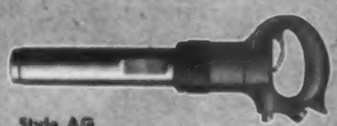
Secondly, you get more power, because in the large reservoir, surrounding the valve block, air is stored and pressure built up between blows. Thus air is impacted in volume on the piston at each stroke, greatly increasing the power of the blow.

Thirdly, Cleco Riveters are more durable! Handle is drop forged, heat treated for strength and resistance to fatigue stresses. Cylinder is of alloy steel, hardened and ground to perfect size and surface. Honing adds to the life of interior surfaces, insures lasting efficiency.

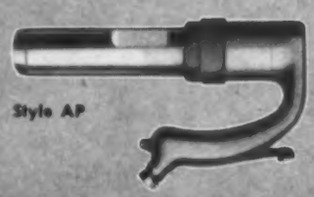
Ask for Bulletin 82 *that fully describes Cleco Riveters—both general industry models and aircraft types.*

3 CONVENIENT HANDLE STYLES

Style AO



Style AG



Style AP

For Best Results Use CLECO ACCESSORIES!

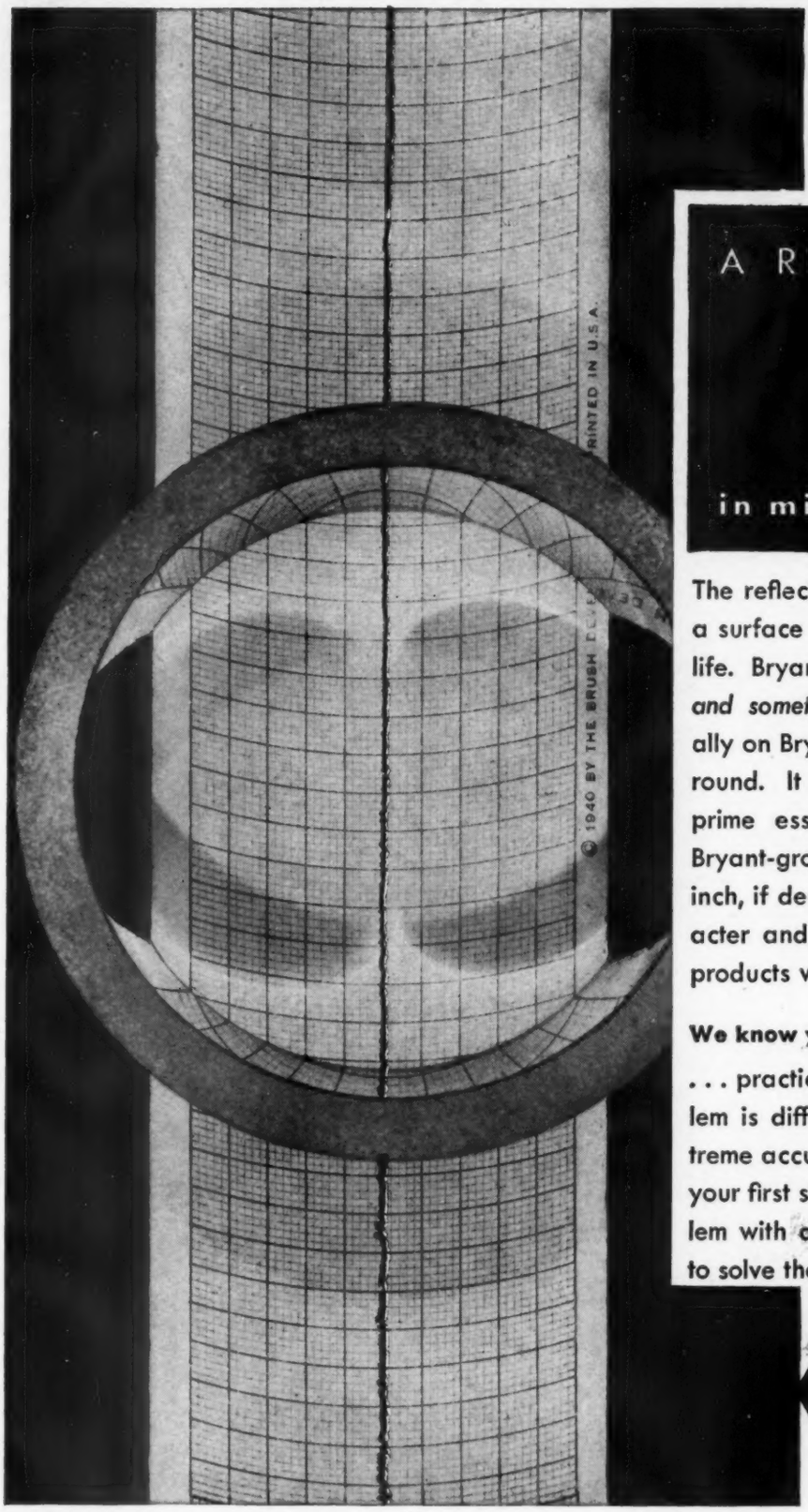
LINE STRAINER AND OILER traps trash and moisture, eliminates troubles due to insufficient lubrication.

VERIBEST AIR HOSE is extra tough, withstands rough treatment. Shown here with **BOWES COUPLINGS.**

THE CLEVELAND PNEUMATIC TOOL CO.

3781 EAST 77th STREET • CLEVELAND 5, OHIO

Branch Offices in All Principal Cities



A REFLECTION OF

in millionths of an inch

The reflection in the bushing, at left, shows a surface finish which assures long bearing life. Bryant Grinders assure fine work finish *and something more*—work ground internally on Bryant Grinders is also straight and round. It is the combination of these three prime essentials that gives character to Bryant-ground parts—in millionths of an inch, if desired. These essentials give character and long life to the assemblies and products which you manufacture.

We know your problem is different

. . . practically every internal grinding problem is different, but when you require extreme accuracy or high production, *or both,* your first step should be to study your problem with a man who makes it his business to solve them. Your first step should be to—

Send for the Man from Bryant!

This bushing, with hole ground in a Bryant Grinder, was checked for surface accuracy. The chart line shows deviation. Distance between vertical lines represents one-millionth of an inch.

BRYANT

BRYANT CHUCKING GRINDER CO.
SPRINGFIELD, VERMONT, U. S. A.

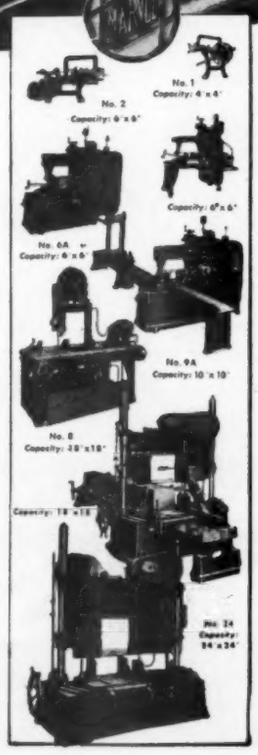
LIGHTNING REVERSALS without shock

Long Life of Taps, Accurate Depths and Class Three Fits can be had when you use **LELAND - GIFFORD** Reversing Motors for Tapping.

The same spindle can be instantly changed to a drilling spindle.

Bulletins 300B and 400A explain. Send for them.

LELAND-GIFFORD



FASTEST SAWS GIVE FASTEST SERVICE

With these four modern MARVEL SAWS, the Hamilton Steel Co. of Cleveland is building a reputation for fast service on orders for accurately cut lengths and pieces. They use a Universal No. 8 MARVEL Metal-cutting Band Saw for the big work (up to 18" x 18"), for angle cuts (at any angle in a 180° radius), for knotching, mitering and roughing to size and shape. For high speed cutting-off from bar stock up to 10" x 10", they have three No. 9A MARVEL Production Saws. These "fastest saws built" are used for cutting-off single pieces, or with their automatic bar-push-ups, for automatically reducing single or nested bars to slices (as gear blanks) or identical lengths, faster than is possible, with equal accuracy by any other method.

With 9 distinct types of MARVEL Metal-cutting Saws; with the positively unbreakable MARVEL High-Speed-Edge Hack Saw Blades; and, with MARVEL Band Saw Blades, the MARVEL System of Metal Sawing has a better way for doing innumerable metal-cutting jobs. If you have a difficult metal sawing problem or just want a saw, MARVEL is your logical source.

For quick reference, see our section in Sweet's File—Mechanical Industries, or write for catalog.

Write us or check with your local MARVEL Distributor.

ARMSTRONG-BLUM MFG. CO.

"The Hack Saw People"

5700 BLOOMINGDALE AVE. **CHICAGO 39, U.S.A.**

Eastern Sales Office: 225 LAFAYETTE ST., NEW YORK 12, N. Y.

MARVEL SAWS

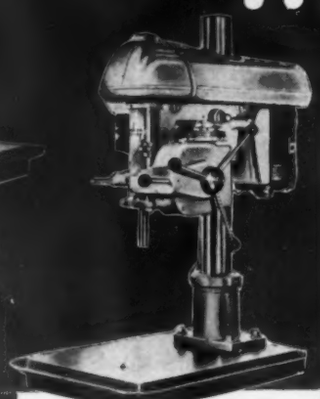
Walker-Turner

MACHINE TOOLS

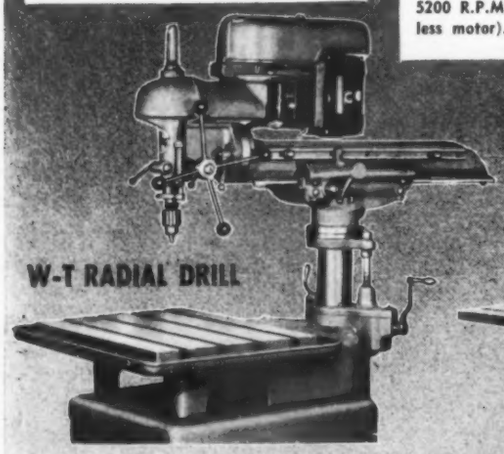
Cut Production Costs

...4 WAYS!

W-T Radial Cut-Off Machine
Cuts all materials, Ram glides on 8 ball bearings. Head operates at any angle. $374.00 (with 2 or 3 H.P. geared motor).

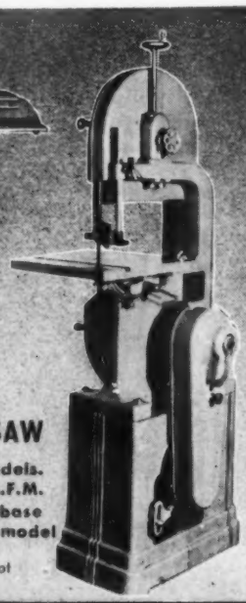


W-T 20 Inch Drill Press
12 Models—1 to 6 spindles. 260 to 5200 R.P.M. $255.00 (bench model less motor).



W-T RADIAL DRILL

Speed ranges—110 to 8300 R.P.M. Head tilts 45° each way. *$382.50 (less base and motor).



W-T BAND SAW
14" and 16" models. 200 - 5300 S.F.M. *$127.50 (less base and motor-14" model

*Prices slightly higher west of Rockies and in Canada

1 LOW INITIAL COST

Walker-Turner low prices are a direct result of sound engineering, volume production and manufacturing know-how.

2 LOW OPERATING COST

Elimination of unessential weight, simplified controls, choice of *correct* cutting speed for each material, contribute to marked savings in power. Maintenance costs are unusually low.

3 WIDE SPEED RANGES

The W-T Radial Drill is typical. With 1740 R.P.M. motor, the spindle speeds range from 160 to 8300 R.P.M. The speed can be adapted to the material—at substantial tool and production savings.

4 MULTI-PURPOSE DESIGN

W-T Machine Tools are being applied in standard or special set-ups to a wide variety of operations. Multiple set-ups solve many intricate tooling problems at greatly reduced cost.

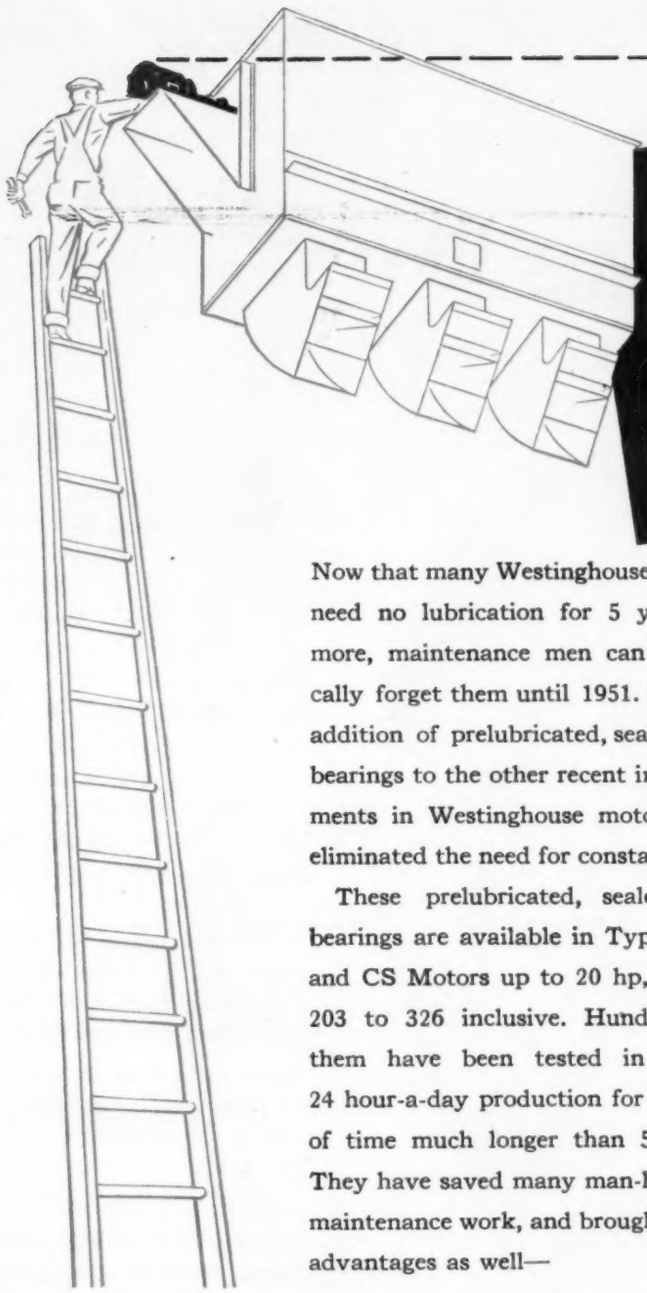
WALKER-TURNER COMPANY, INC.
PLAINFIELD NEW JERSEY

walker-Turner
COMPANY, INC.
PLAINFIELD, N.J.
U.S.A.

MACHINE TOOLS

DRILL PRESSES — HAND AND POWER FEED • RADIAL DRILLS
METAL-CUTTING BAND SAWS • POLISHING LATHES • FLEXIBLE SHAFT MACHINES
RADIAL CUT-OFF MACHINES FOR METAL • MOTORS • BELT & DISC SURFACERS

INSTALL TODAY...



DON'T LUBRICATE until 1951!

Until 1951, there's no need to have anyone climb a ladder to lubricate this motor.

Now that many Westinghouse motors need no lubrication for 5 years or more, maintenance men can practically forget them until 1951. For the addition of prelubricated, sealed ball bearings to the other recent improvements in Westinghouse motors, has eliminated the need for constant care.

These prelubricated, sealed ball bearings are available in Types CSP and CS Motors up to 20 hp, frames 203 to 326 inclusive. Hundreds of them have been tested in actual 24 hour-a-day production for periods of time much longer than 5 years. They have saved many man-hours of maintenance work, and brought other advantages as well—

- No overgreasing
- No "skipped" bearings
- No grease contamination
- No grease seepage
- No unreplaced pipe plugs

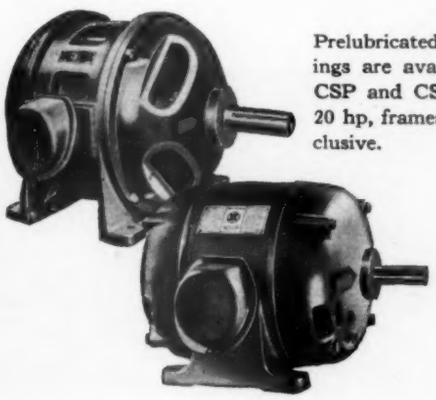
This freedom from frequent lubrication brings also a greater freedom to engineers designing new equipment or laying out plants. They can now place motors most advantageously for their operation—unhampered by questions of accessibility and ease of greasing. For further details, write for Bulletin B-3554 and Descriptive Bulletins 3100-CSP and 3100-CS-1, to Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa.

J-21377

Westinghouse

PLANTS IN 25 CITIES... OFFICES EVERYWHERE

Squirrel Cage Motors



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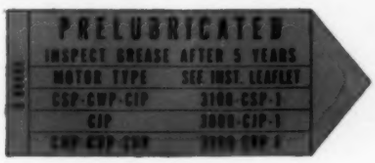
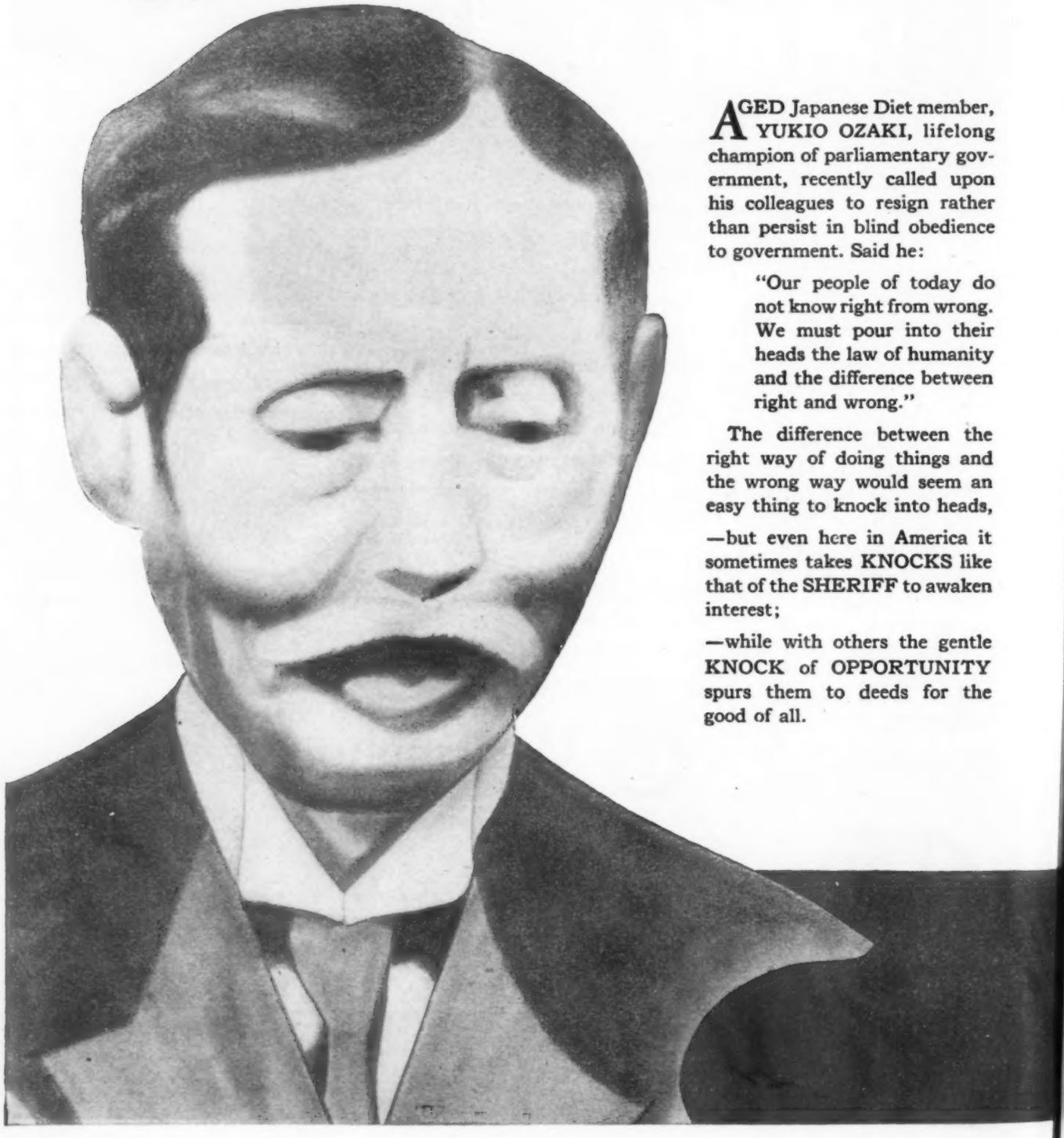


Another Westinghouse "first"—this label identifies motors that you "don't lubricate for 5 years or more".

then he said to himself:

"Beat their brains IN . . . not out"



AGED Japanese Diet member, YUKIO OZAKI, lifelong champion of parliamentary government, recently called upon his colleagues to resign rather than persist in blind obedience to government. Said he:

> "Our people of today do not know right from wrong. We must pour into their heads the law of humanity and the difference between right and wrong."

The difference between the right way of doing things and the wrong way would seem an easy thing to knock into heads,

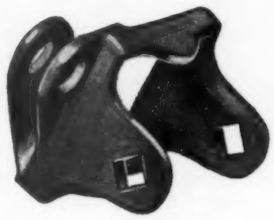
—but even here in America it sometimes takes **KNOCKS** like that of the **SHERIFF** to awaken interest;

—while with others the gentle **KNOCK** of **OPPORTUNITY** spurs them to deeds for the good of all.

The difference between RIGHT and WRONG . . . *he says*

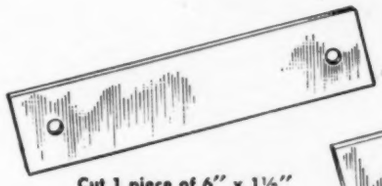
LOOK, OZAKI . . . Here is the difference between RIGHT and WRONG in manufacturing a bracket such as shown:

WRONG:

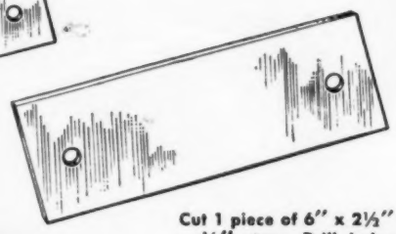


Cost 13¢ each
of conventional construction.

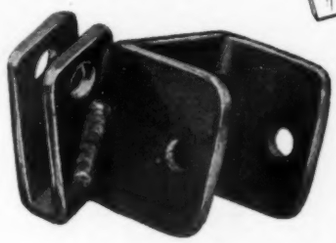
RIGHT:



Cut 1 piece of 6" x 1½" x ¼" strap. Drill holes in ends. Bend in U.



Cut 1 piece of 6" x 2½" x ¼" strap. Drill holes in ends. Bend in U.



Fit up in jig and weld on both sides.

Cost 8¢ each
of welded steel.

DIFFERENCE: Saved 5¢ Each

This bracket, 10 of which are used on each harrow, is typical of many parts changed over to welded design by an implement manufacturer. Perhaps your product has similar parts. The Lincoln Engineer will gladly help you study the possibilities of welded design as applied to your problems.

STUDIES IN MACHINE DESIGN . . . issued periodically. Free on request. Ask for them on your business letterhead.

THE LINCOLN ELECTRIC COMPANY
DEPT. I-1 • • CLEVELAND 1, OHIO

The RIGHT Ways to Control Distortion

The new Lincoln sound-color movie, "The Prevention and Control of Distortion in Arc Welding", by Walt Disney Productions, explains simply and clearly the causes and cures of distortion. A valuable aid to designers and production men. Available free for showing to groups. Ask for Bul. 709.

America's greatest natural **recourse**

ARC WELDING

HALLOWELL

UNBRAKO

Reg. U. S. Pat. Off.

this is the house that

"HALLOWELL" *and* "UNBRAKO" *products built*

These are the grounds and the buildings that "Hallowell" and "Unbrako" products built.

These are the shops that house the equipment that makes the "Hallowell" and "Unbrako" products.

In these shops are the workers who take pride in the jobs they do, in making "Hallowell" and "Unbrako" products.

Here is the up-to-date machinery and appliances... the knowledge and skill that have made "Hallowell" and "Unbrako" products outstanding in their fields, embodying many new and unique features that have been saving time, money and labor for thousands of users all over the country.

ARMY (E) NAVY

OVER 40 YEARS IN BUSINESS

STANDARD PRESSED STEEL CO.

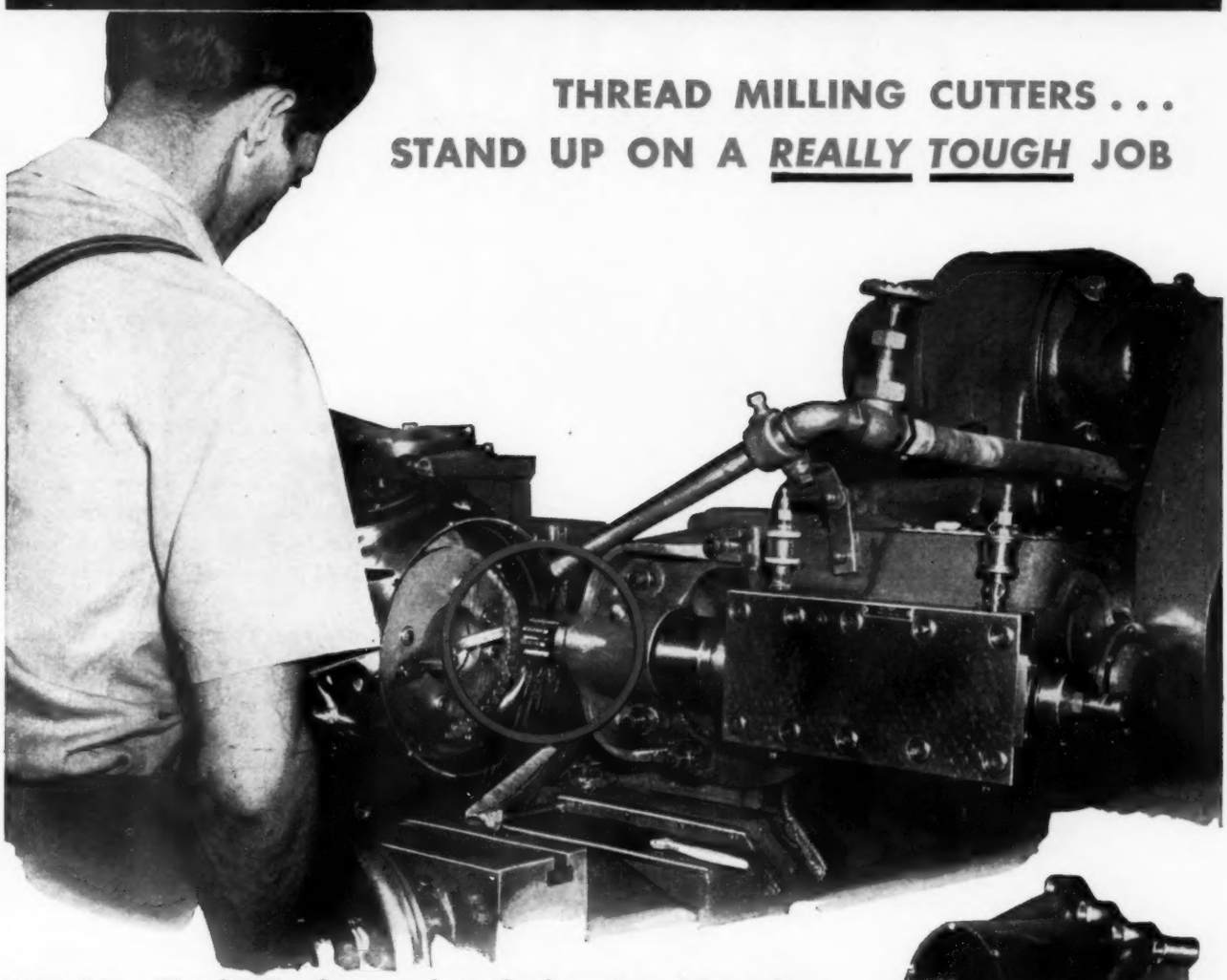
JENKINTOWN, PENNA., BOX 4

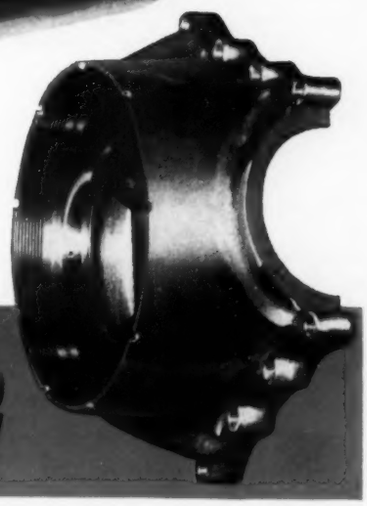
BOSTON • CHICAGO • DETROIT • INDIANAPOLIS • SAN FRANCISCO • ST. LOUIS

BARBER-COLMAN

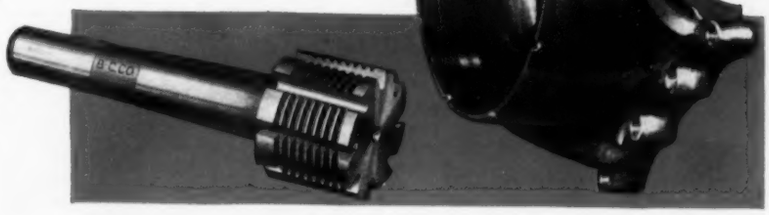
HOBS • HOBBING MACHINES • HOB SHARPENING MACHINES • MILLING CUTTERS
REAMERS • REAMER SHARPENING MACHINES • SPECIAL TOOLS

THREAD MILLING CUTTERS . . . STAND UP ON A *REALLY TOUGH* JOB





Barber-Colman Thread Milling Cutters are designed and manufactured for *maximum performance.* As the result of experienced engineering, careful selection of material, and exacting standards of machining, heat treatment, finish, and inspection, they are performing *accurate work with long tool life* under even the most difficult conditions. The quality thus built into Barber-Colman Thread Mills will give you efficiency and greater production at lower overall tool cost. *Use Barber-Colman Cutters for your thread milling jobs — and especially the tough ones.*



JOB FACTS

CUTTER—1-3/4" diameter x 1-3/8" face x 5-7/8" O.A., Shank Type.
Produces 100-120 pieces total life.
Feed 1.707" per minute — speed 130 R. P. M.

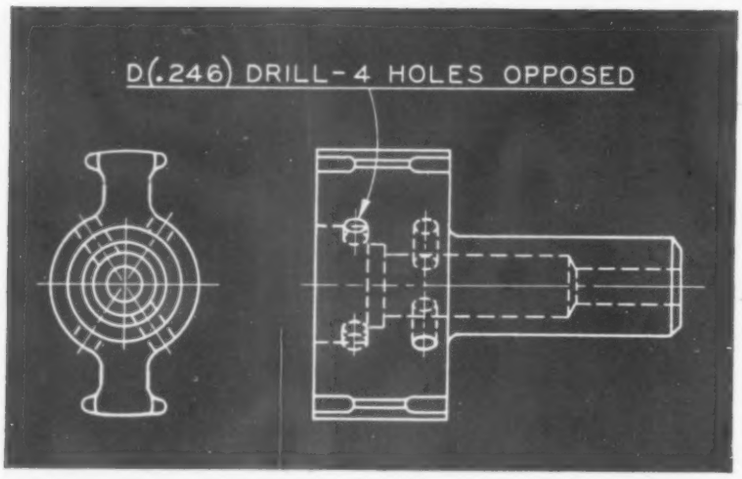
THREADS—8P Acme on 10.4425" diameter.
Alloy steel heat treated to 235-263 Brinell.
Checked with GO — NOGO gages.

BARBER-COLMAN COMPANY

HOBS, HOBBING MACHINES, HOB SHARPENING MACHINES, REAMERS, REAMER SHARPENING MACHINES, MILLING CUTTERS, SPECIAL TOOLS

GENERAL OFFICES AND PLANT • 111 LOOMIS STREET • ROCKFORD, ILLINOIS, U.S.A.

There are 2 ways to do this job—
1. The EXPENSIVE WAY . . . or
2. The FLEXIMATIC *by KINGSBURY*

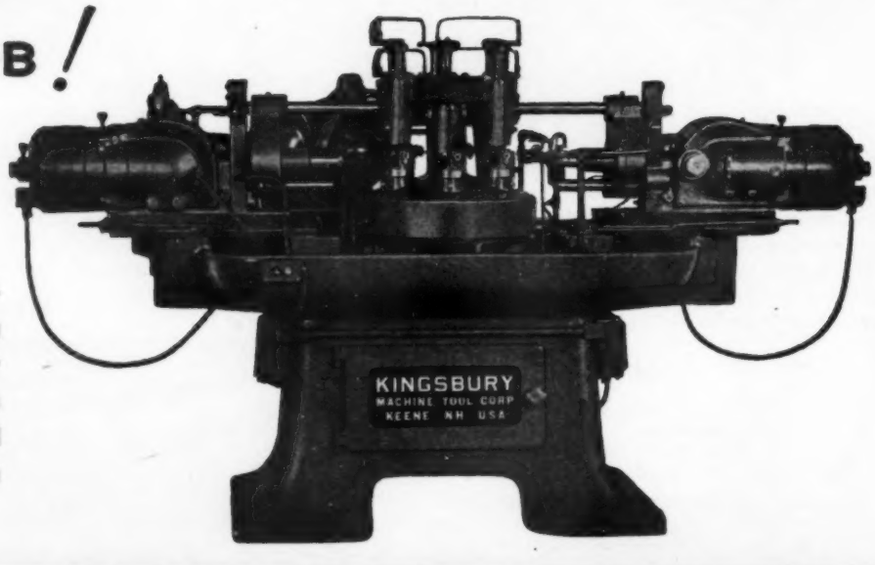


WAY

The expensive way to drill the four opposed holes in this shock absorber part would be to use a general-purpose drilling machine. Production would be limited to one hole at a time and by operator skill in manual indexing, etc. The FLEXIMATIC way uses standard Units set up on a standard base around an automatically indexing turret. The only manual operations are loading and unloading, and even as these are being performed the Units are drilling work already loaded.

FLEXIMATICS combine the speed and efficiency of a special purpose machine with the valuable advantages obtained by the flexible set-up.

Standard Kingsbury Units for drilling, reaming, boring, spot facing and many milling operations may be mounted in any combination on standard bases and changed over to meet varying designs on machinery requirements.

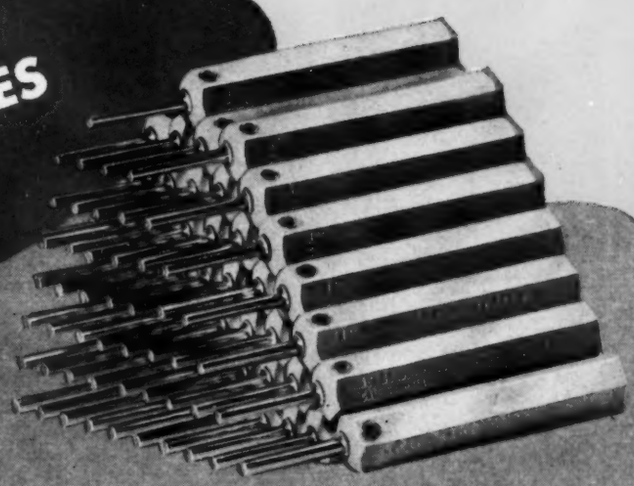


KINGSBURY MACHINE TOOL CORPORATION
KEENE NEW HAMPSHIRE U S A

ANNOUNCING

Van Keuren

CARBOLOY WIRE TYPE PLUG GAGES



1 VAN KEUREN CARBOLOY GAGE = 50 TOOL STEEL GAGES

Wire type plug gages were originated by The Van Keuren Co. in 1925 and are now recognized as the most economical gages for measuring small holes.

The original wire type plug gages were made of tool steel. The use of high speed steel doubled gage life. Precision chrome plate gave five times the life, and now gages of carboloy are available with fifty times the life of tool steel. All of these materials are still in use and have their particular applications and advantages.

VK Carboloy gages are made in sizes from .020" diameter to .250" diameter. They are available only in the wire type design as this is by far the most economical small plug gage. In cases where it is desired to use Van Keuren carboloy wire type Go units with existing No Go units of the taper insert design, special handles can be furnished for this purpose. Van Keuren wire type plug gages assure longer lasting precision and lower gage cost because the entire 2" length of gage unit can be used. When the end becomes worn it is ground off and a new section of the original accuracy is moved out for use. The wire type unit is securely held in the handle by a split bushing and a headless set screw.

VK Carboloy wire type plug gages are made to Class B accuracy, plus .00005" minus .00000" on the Go unit and plus or minus .000025" on the No Go unit. Closer or wider tolerances can be supplied if desired.

On your next order specify VK wire type plug gages. VK Carboloy for long runs because of the enormous saving in gage cost. VK Carboloy for fussy jobs because of the infinitesimal gage wear and insurance that the parts will be within the specified limits. VK Tool Steel,—High Speed—Precision Chromium for less exacting jobs. You will be assured of the best in accuracy, quality and delivery.

Write for circular C 35 on Carboloy wire type plug gages, Thread measuring wires and Gear wires.

Write for your copy of catalog and handbook No. 33. It contains complete information on Van Keuren precision gages and instruments and valuable engineering formulas and data on measuring problems.

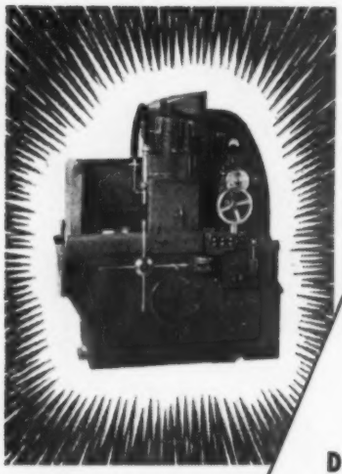
THE Van Keuren CO., 176 WALTHAM ST., WATERTOWN, MAS

27th YEAR

Light Wave Equipment • Light Wave Micrometers • Gage Blocks • Taper Ins Plug Gages • Wire Type Plug Gages • Measuring Wires • Thread Measur Wires • Gear Measuring System • Shop Triangles • Carboloy Plug Gages Carbolox Measuring Wires.

IF YOU MACHINE FLAT SURFACES...

these examples of actual production should interest you!



The Blanchard No. 11 Surface Grinder

A Forty-eight cast iron pump bodies, 6 inches diameter, are ground per hour, removing .012 inch of metal to limits of +.0003 inch —.0001 inch.

B Seventy-two cast iron ball bearing spacer rings 3 inches to 5 inches diameter are ground on both ends per hour, removing .025 inch of metal from each end, to limit for parallelism of .0002 inch.

C Fifteen alloy steel plates, 24¼ inches x 5⅜ inches and 1 1/32 inches are ground per hour, removing .015 inch of metal from each side, then finish grinding the first side removing .010 inch of metal, a total of .040 inch from the two sides, to limits of ±.00075 inch.

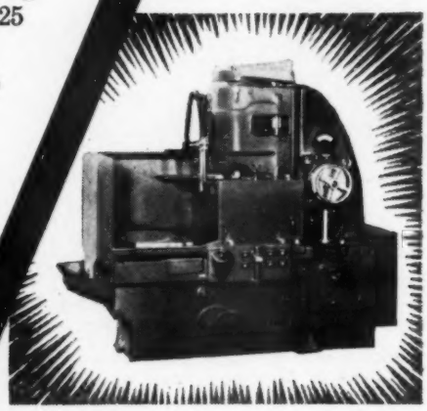
D One semi-steel swivel table for Shaper is ground in one hour and thirty-five minutes, grinding six sides, removing ⅛ inch of metal from each side. These tables are finish ground from rough castings 15½ inches x 16 inches x 16 inches to limits of ±.005 inch for dimensions and finished table must be square within .0015 inch in 16 inches.

E 150 alloy steel pump plates, 2⅜ inches x 1⅞ inches x ½ inch, are ground per hour on both sides, removing .009 inch of steel from each side, to limits of ±.00025 inch.

F 109 forged, nickel steel airplane engine cams, 10¾ inches x 8¾ inches x ⅞ inch are ground per hour on both sides, removing from .040 inch to .060 inch of metal from each side to limits of ±.001 inch.

Send for your free book of "Work Done on the Blanchard", third edition. This new book shows over 100 actual jobs where the Blanchard Principle is earning profits for Blanchard owners.

The Blanchard No. 18 Surface Grinder



IF YOU MACHINE FLAT SURFACES...

bring your problems to,

BLANCHARD

The BLANCHARD MACHINE COMPANY

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The choice of Brown & Sharpe Tools by over three generations of skilled users attests their high accuracy and fine qualities. Such advantages, expressed in results, mean good work, accurately sized and produced fast. Catalog sent on request. Brown & Sharpe Mfg. Co., Providence 1, R. I., U. S. A.

B·S

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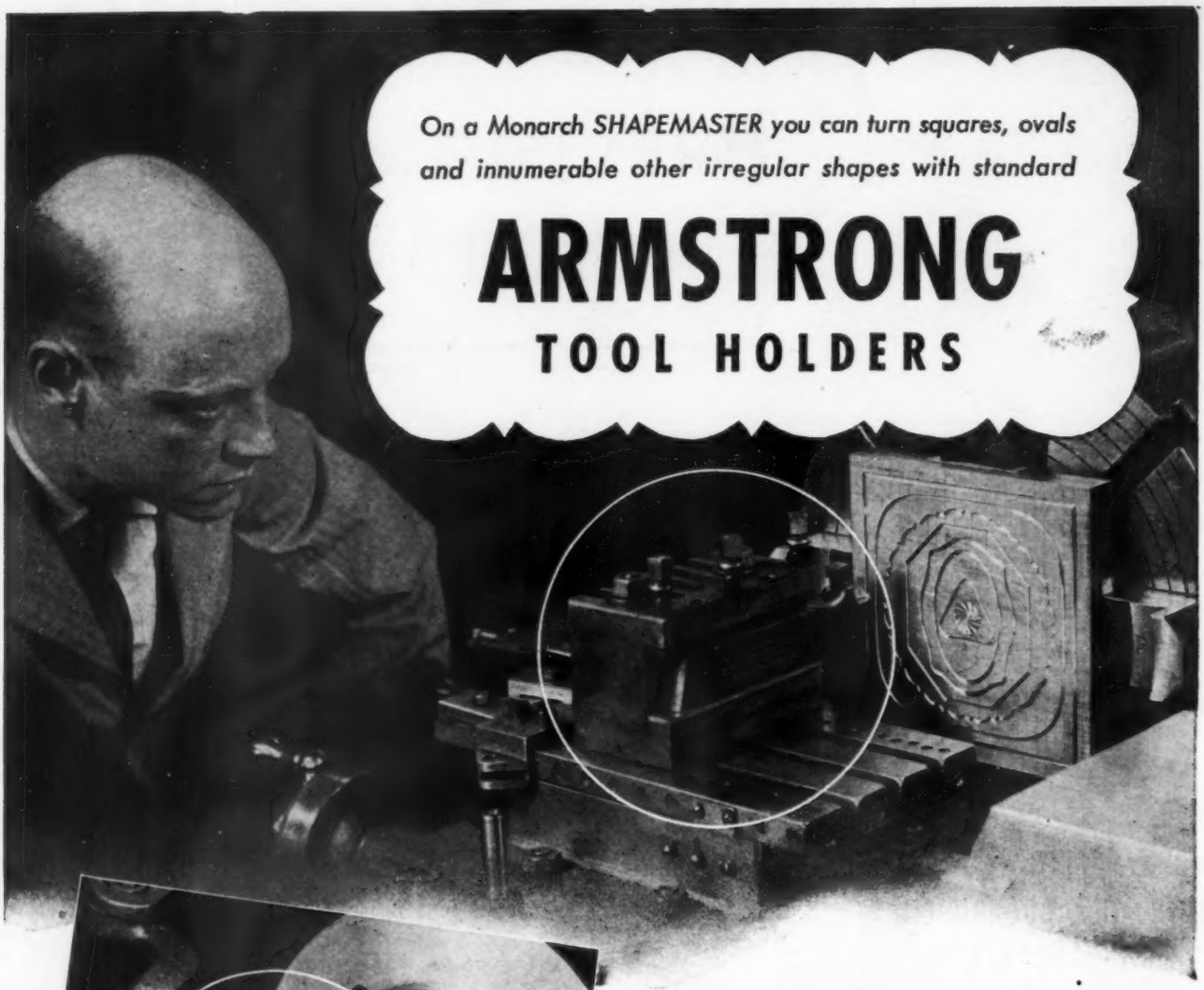
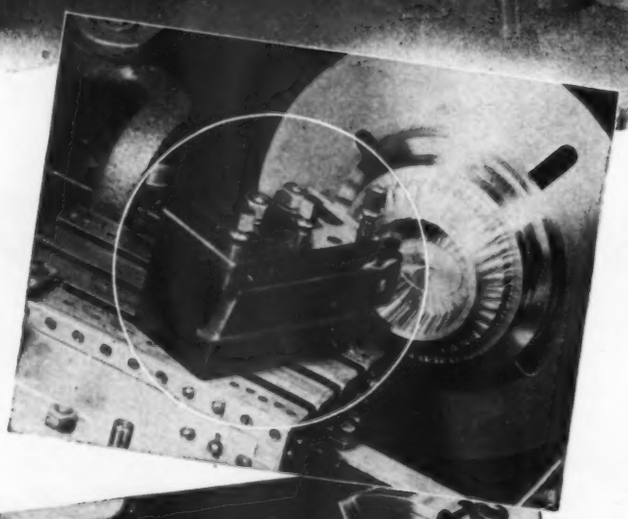
U·E

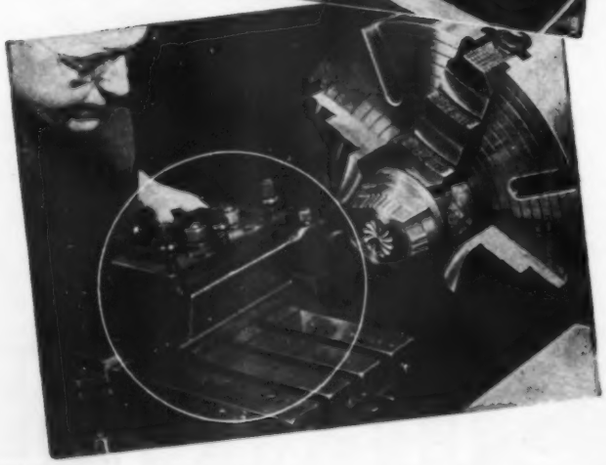
BROWN & SHARPE TOOLS

On a Monarch SHAPEMASTER you can turn squares, ovals and innumerable other irregular shapes with standard

ARMSTRONG
TOOL HOLDERS







The phenomenal Monarch SHAPEMASTER performs the most astonishing operations. Basically a 20" Monarch Lathe, when fitted with the SHAPEMASTER Mechanism, it will turn squares, ovals, hexagons, octagons and multiple sided shapes in irregular contour pieces. Almost any desired shape can be transmitted by the cutting point to either outside or inside diameter or face of the work.

The result of many years of engineering and development, the SHAPEMASTER is distinctly *modern* and advanced in its design in every detail. Still, for most of its unusual operations it is tooled with ARMSTRONG TOOL HOLDERS, of the standard types universally used on ordinary lathes in 96% of the machine shops and tool rooms.

These ARMSTRONG TOOL HOLDERS are selected not only because they "Save: All Forging, 70% Grinding and 90% High Speed Steel" but also because they have the strength to support the cutting edge rigidly not only against a normal down feed but against end thrust, side and torsional strain as well.

ARMSTRONG BROS. TOOL CO.
"The Tool Holder People"
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199 Lafayette St., New York 12, N. Y.
Pacific Coast Whse. and Sales Office:
1275 Mission St., San Francisco 3, Calif.

INGERSOLL FACE MILL CUTTERS

Available from Stock

TYPE NX Heavy Duty Series face milling cutters designed for geneal purpose work are suitable for taking ½" cuts on both the face and periphery in cast iron or steel. Serrated high speed steel blades are locked in the cutter housing by wedges and screws. Chip clearance is milled in the housing to prevent chips clogging on heavy cuts. The following sizes are available in stock both right and left hand.

Cutter No.	Diameter	No. Blades	Cutting Face on Periphery	Price
8104X	4"	10	1-¾"	$30.00
8106X	6"	10	2-½"	35.00
8108X	8"	14	2-½"	45.00
8110X	10"	18	2-½"	60.00
8112X	12"	20	2-½"	78.00

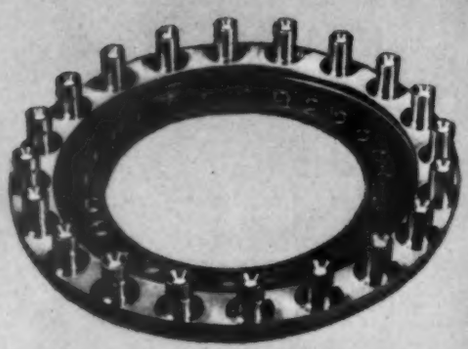
SHEAR CLEAR Heavy Duty Series face milling cutters will out-perform any existing designs for work in tough steel and in the soft, stringy, non-ferrous metals. Designed for ½" deep cuts. The Shear Clear is a patented design using steep negative rake and positive shear angles which cause chips to coil outward away from the cutter. The following sizes with high speed steel blades are available in stock both right and left hand:

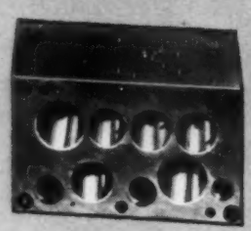
Cutter No.	Diameter	No. Blades	Price
7106X	6"	12	$58.00
7108X	8"	16	75.00
7110X	10"	20	100.00
7112X	12"	22	120.00

Write for catalog giving complete details on inserted blade milling and boring tools.

THE INGERSOLL MILLING MACHINE CO., ROCKFORD, ILLINOIS

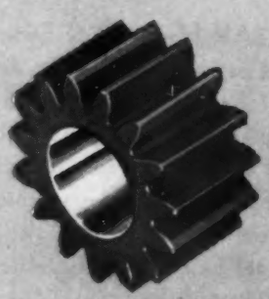
What Cost— a BORE?





Bores—millions of bores—dowel pin bores—bearing bores—engine cylinder bores—all these and other bores, essential to high quality products—require low cost manufacturing techniques as well as precision.

Industry has always had to spend a lot of its time and money generating precision in bores. Specifications and standards continually become stiffer. Available methods have produced good technical results but they have usually cost too much in time and money.



Microhoning — the modern hone abrading method has recently developed new controls which, at production speeds, generate sufficiently high accuracy and size precision to make possible complete interchangeability of all duplicate parts. Selective fits are no longer necessary when microhoning becomes the final machining process.

Stock removal is at high rates. From .010" to .080" of stock may be removed by Microhoning at rates from .006" to .008" per minute.

If you face new standards of precision in bores which look impossible, investigate Microhoning. It has provided the means to meet many "impossible" demands.

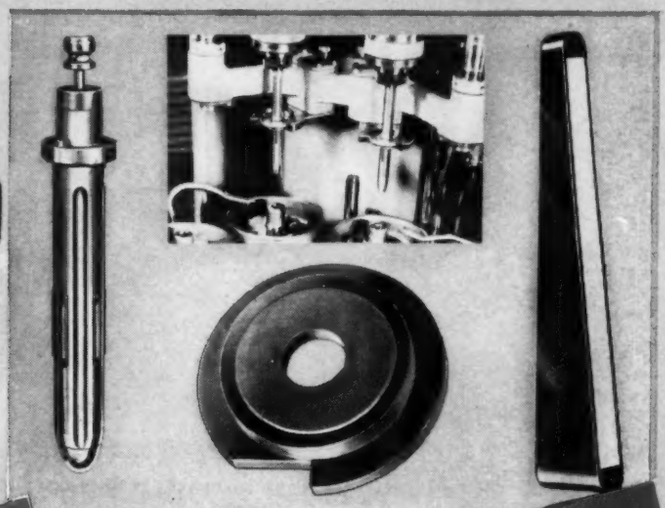
MICRO MATIC

MICROMATIC HONE CORPORATION
DETROIT 4, MICHIGAN

These Machines Produce *Precision Bores* FAST

Micromatic Honing Machines and Honing Tools are built to meet a wide range of Microhoning needs. They provide any desired precision—dimensional accuracy—roundness and straightness in bores—at high production rates.

MICROMATIC MODEL 705 MULTIPLE SPINDLE VERTICAL HYDROHONER



MICROMATIC MICROSIZE CONTROL

Has built-in automatic Microsize Control. For internal honing. Rotary indexing work table provides high production. Usually recommended for maximum stock removal ranging from .0005" to .0015" on hardened parts—.001" to .010" on soft or medium hard. Bores from ¼" to 2" diameter. Microsize control gauges work automatically. Work is held uniformly within tolerances of .0003". Honing cycle is automatically stopped when correct size is reached. Automatically holds size within limits of .0001" to .0003" in most applications.

Micromold Honing Sticks are expanded as the tool is honing the bore in combined reciprocating and rotary motion. The expanded sticks act as a plug gage within the selective sizing ring.

As soon as the sticks expand enough to bind on the inner surface of the sizing ring, the ring turns automatically shutting off the machine.

MICRO MATIC

MICROMATIC HONE CORPORATION

DETROIT 4, MICHIGAN

DISTRICT OFFICES: 614 Empire Building, 206 South Main St., Rockford, Illinois • 129 Church St., New Haven 10, Connecticut
501 Harries Building, 137 North Main St., Dayton, Ohio • 1031 South Broadway, Los Angeles 15, California

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THERE'S nothing better than aluminum for washing machines. Aluminum is light—easy to handle, easy to move, resists corrosion. Aluminum helps give washing machines better operation, longer life, lighter weight.

Then how about *your* product? Couldn't it, too, make use of these advantages? And, besides, aluminum machines easily—and is readily cast into intricate shapes. Wartime progress has made aluminum alloys even stronger than before.

Why not ask Acme about the advantages of "aluminizing" your product? Acme engineers have spent many years of work and study on aluminum and its alloys. And they are always glad to lend a hand in any problem of design.

Acme Aluminum Permanent Mold (and Sand) Castings are produced in one of the largest, newest and best-equipped foundries in the United States. Consult Acme on your castings problems, without obligation.

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Every modern facility is available here for the quantity production of ***better*** small gears. Practically every precision testing device known . . unique methods . . finest machinery . . a skilled, long experienced staff of gear specialists . . all these essentials and more are brought to bear upon YOUR Small Gear problem when you entrust it to our care. G.S. Gears are indeed "made with fine watch precision" . . custom built to a degree of quality and ***uniformity,*** we believe unapproached so far in the manufacture of fractional horsepower gears.

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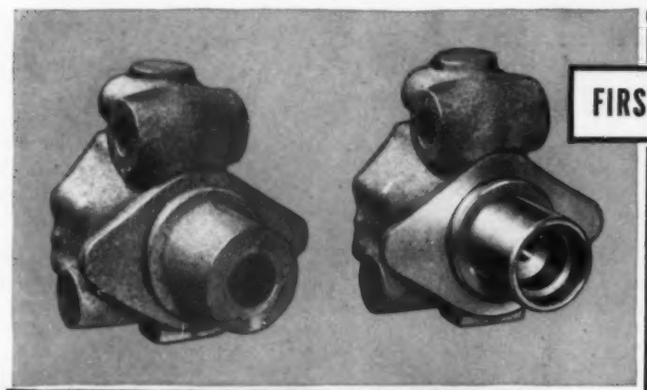
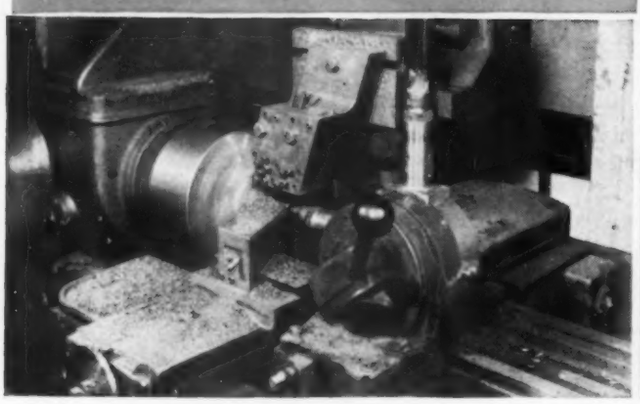
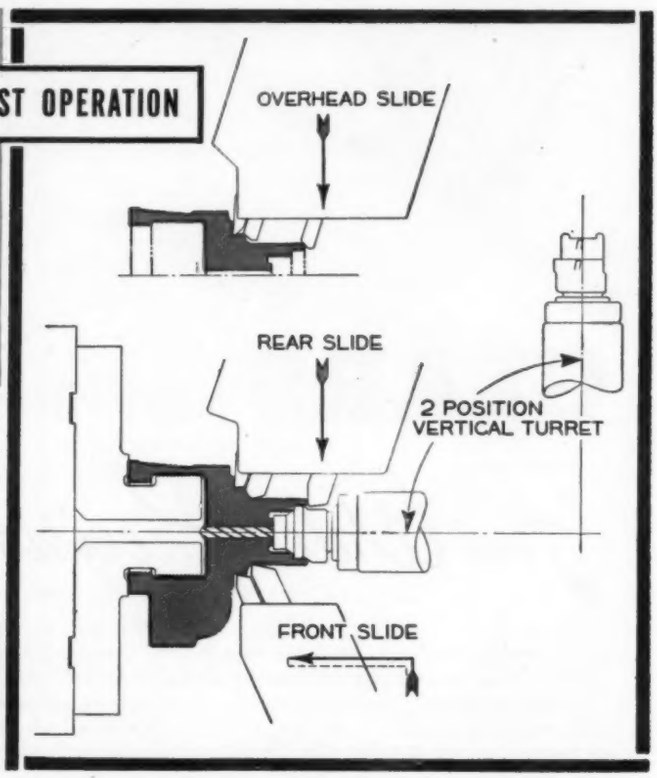
HOW MULTIPLE TOOL TURNING INCREASED PRODUCTION OF PUMP BODIES

TWO SUNDSTRAND AUTOMATIC LATHES MACHINE 26 SURFACES TO REDUCE TIME FROM 9.7 MINUTES TO 5.9 MINUTES PER PART

Here's an excellent example of how Sundstrand Automatic Lathes can be multiple tooled to simplify processing and increase production over other turning equipment. This cast iron pump body part formerly required 3 operations to do the turning, boring, facing and drilling of the center hole at a rate of 9.7 minutes per part. Changing the job to Sundstrand Automatic Lathes with multiple tooling (as shown in diagrams) made it possible to do the same machining in 2 handlings of the part and reduced the time per part from 9.7 minutes to 5.9 minutes. In addition to this profitable increase, parts are consistently duplicated accurately and the operator's duties simplified due to the automatic machine cycle.







Above: Rough and finish part on first setup. Tooling close-up and tooling diagram.
Opposite Page: Rough and finish part on second setup. Tooling close-up and tooling diagram.

ADDITIONAL FEATURES OF SUNDSTRAND LATHES FOR BOTH LONG AND SHORT RUN TURNING

Simplicity of setup and quick changeover make it possible to turn both long and short run work profitably on Sundstrand Automatic Lathes. It will pay you to investigate these features. Further, have Sundstrand engineers assist you with tooling recommendations. There is no obligation for this service.

SUNDSTRAND MACHINE TOOL CO. ROCKFORD ILLINOIS U.S.A.

RIGIDMILLS | FLUID-SCREW RIGIDMILLS | AUTOMATIC LATHES | HYDRAULIC EQUIPMENT

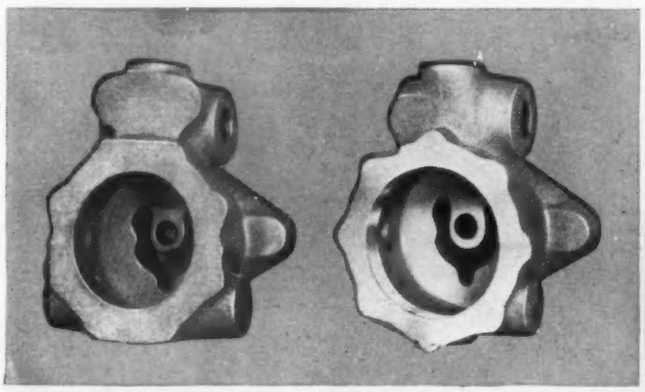
MACHINE DATA

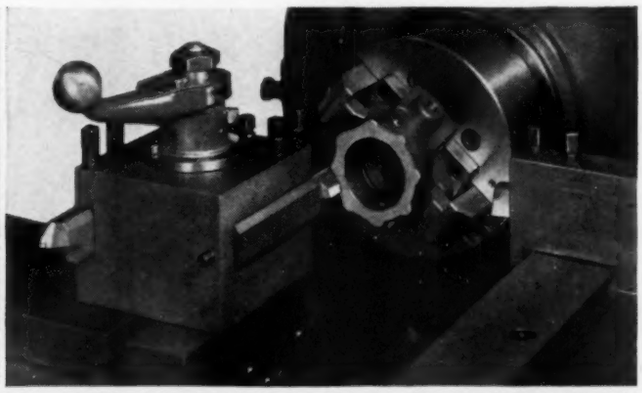
FIRST OPERATION
MODEL 10 SUNDSTRAND AUTOMATIC LATHE

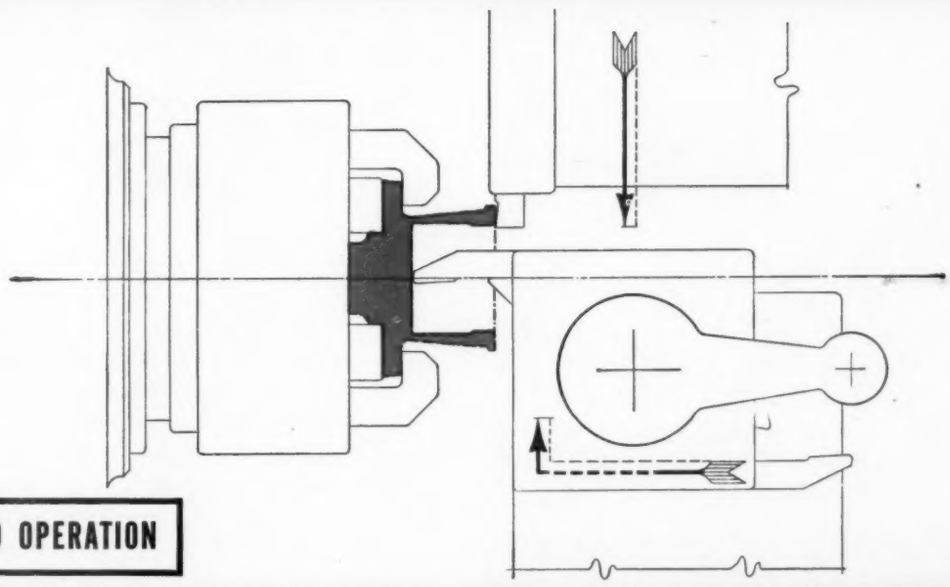
- Rough and finish turn 2 hub diameters, rough and finish face and undercut shoulder, rough and finish bore, counterbore and face inside shoulders, face end, chamfer, drill center hole from solid.
- T. C. tipped turning tools, H. S. S. drill.
- Turret type tool holders for rough and finish cuts.

SECOND OPERATION
MODEL 8 SUNDSTRAND AUTOMATIC LATHE

- Rough and finish bore open end, rough and finish face closed end, rough and finish face flange, chamfer inside diameter of flange.
- T. C. tipped tools.
- Turret type tool holders for rough and finish cuts.
- Note skip feed of front tool slide for rapid traverse between separated surfaces.







SECOND OPERATION

FREE! HOW TO CUT TURNING COSTS

This free 44-page booklet contains helpful tips on processing turning jobs, together with illustrations and tooling diagrams. Complete engineering and production data are given on many jobs similar to yours. Write for your free copy today. Ask for bulletin 145.

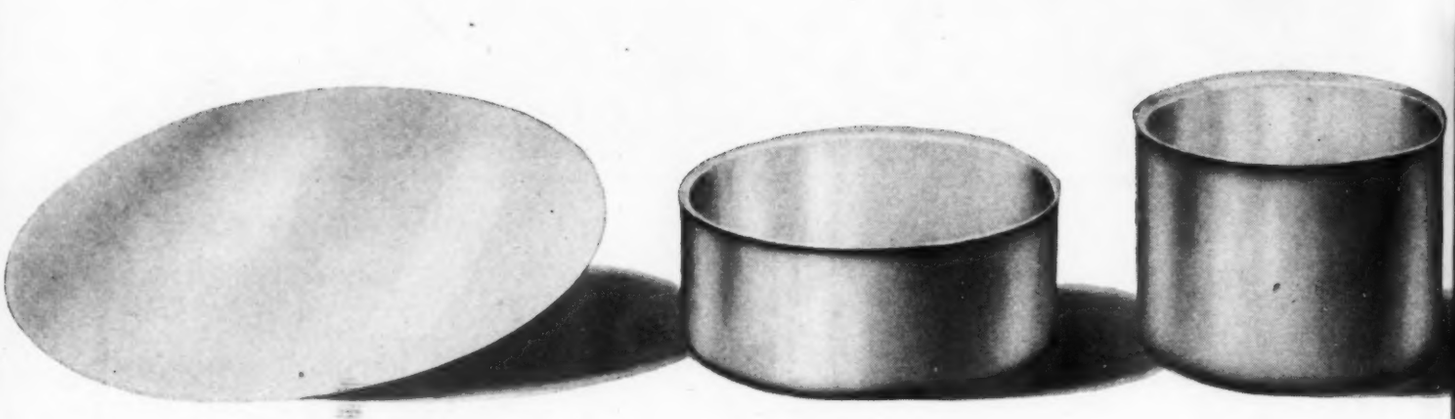
SUNDSTRAND MACHINE TOOL CO. ROCKFORD, ILLINOIS U.S.A.

SUNDSTRAND
MACHINE TOOL COMPANY
2533 Eleventh St. • Rockford, Ill., U.S.A.

DRILLING AND CENTERING MACHINES | SPECIAL MILLING AND TURNING MACHINES

DEEP-DRAWING STAINLESS STEEL

With Controlled Speed and Pressure at Full Length of Stroke



YOU JUST DON'T DRAW the wide variety of seamless stainless steel and aluminum products shown below *on any press.* They demand presses with inherent flexibility for setting dies, for changing strokes and varying speeds and for maintaining uniform, controlled draw and pressure at full length of stroke.

That's why Bliss double-action presses are the choice of a pioneer in deep-drawing seamless stainless steel kitchen and hotel ware—the manufacturers of Crusaderware—Lalance and Grosjean of New York.

With Bliss hydraulic presses Lalance and Grosjean saves set-up time, guards against die breakage—and increases production of uniformly high quality products. Controlled drawing speed, slide within slide construction, separate power-saving blank-holder pump, push-button instant controls plus the exclusive HYDRO-DYNAMIC System, keep Bliss presses busy on short and long runs. Double-action presses are easily converted into single-action units.

These are important factors to consider for *your* future deep-draw work in stainless steel, aluminum, brass and other metals. And good reasons to write today for our 64-page book "HYDRO-DYNAMIC PRESSES" which contains many production examples and advice on *selecting the right press for the job.*

Remember this, too: whatever your press application—mechanical or hydraulic—Bliss can help you.

E. W. BLISS COMPANY, BROOKLYN 32, N. Y.

WORKS AT: Brooklyn; Toledo, Cleveland, Salem, Ohio; Hastings, Mich.; Derby, England; Paris, France. SALES OFFICES: Brooklyn; Toledo, Cleveland, Dayton, Ohio; Detroit, Lansing, Mich.; Chicago; Philadelphia; Rochester; New Haven; Boston; Toronto.

BLISS BUILDS MORE TYPES AND SIZES OF PR

Progressive stages in the deep-drawing of a ten-gallon stainless steel stockpot, starting with a circular blank .102″ thick.

First two draws are illustrated at left and below. Bliss Hydro-Dynamic Presses, used on both stages provide controlled speed and pressure at full length of stroke.

The final draw takes place on a large Bliss-Toledo mechanical double-action press. Lalance and Grosjean, manufacturers of Crusaderware, produce 1200 of these stockpots per day on Bliss presses.

STAY AHEAD WITH Bliss

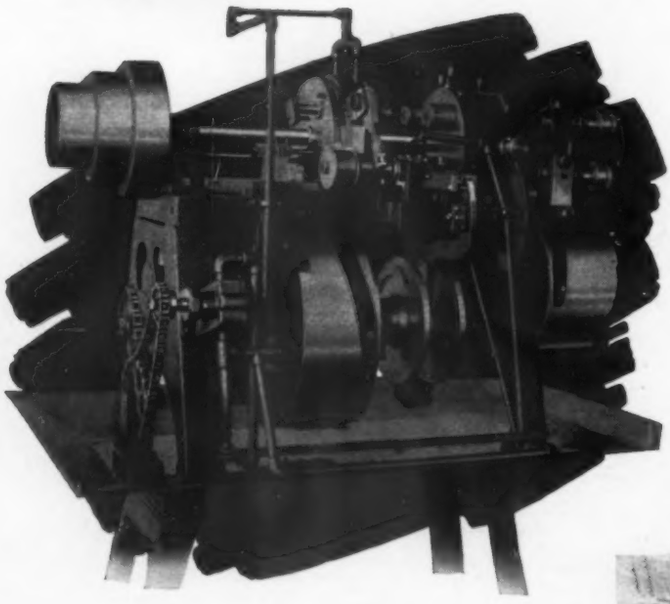
OF PRESSES THAN ANY OTHER COMPANY

"To all to whom t

Fifty years ago, the Patent Office of the United States issued to Edwin C. Henn, founder of The National Acme Company, and to Reinhold Hakewessell the first patent ever to be granted covering a multiple spindle automatic screw machine.

Perhaps it can be said that this was the real beginning of American mass production methods —the first multiple to produce, automatically, identical parts in large quantities.

From this start has grown our nation's ability to turn out vast numbers of automobiles, radios, refrigerators, typewriters, instruments and hundreds of other mechanical aids to working and living—at such low costs that they are within the buying reach of millions, both here and abroad.



This "4-Spindle Acme Automatic" is the first machine produced by National Acme—number one of a series of continuously improved models now totaling more than 40,000.

Here is the shop at Hartford, Conn. in which the first Automatic was produced, and the men who built that machine.

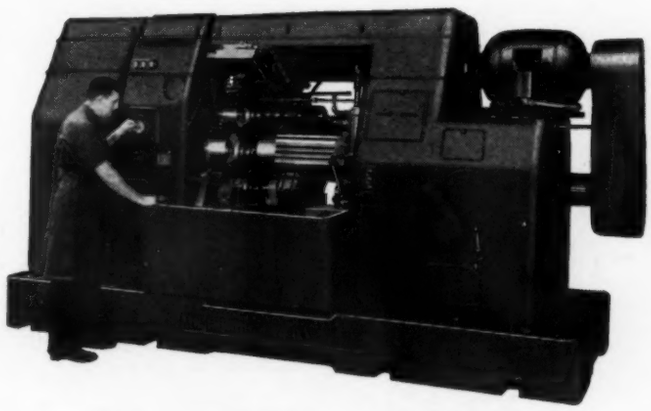
these presents shall come:"

National Acme enters its 51st year of serving industry with an extensive line of 1, 4, 6 and 8-Spindle Acme-Gridley Automatics—both Bar and Chucking types.

Every engineering refinement in these machines is geared to their original purpose—to *reduce the cost* of producing identical precision metal parts—from the smallest up to 12" diameter.

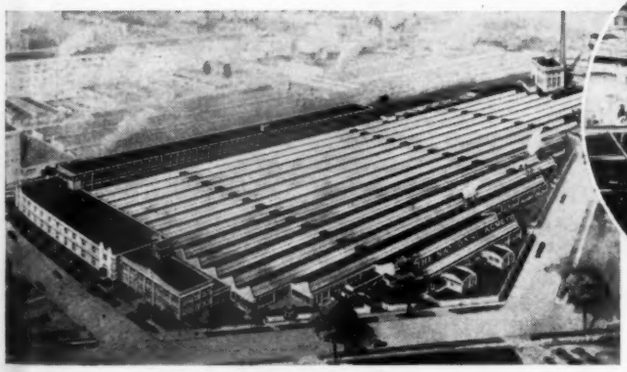
Many of America's largest manufacturing industries depend upon National Acme leadership in Automatics for their ability to create the mechanical marvels without which our wars could not be won, nor our modern standards of living achieved.

Our engineers will be glad to show you the advantages of these modern multiples in terms of guaranteed speeds, finish and lower production costs.



Modern Six Spindle Acme-Gridley Chucking Automatic—Capacity, 12". Weight, 30 tons.

A typical production plant, equipped with Acme-Gridley Multiple-Spindle Automatic Machines.



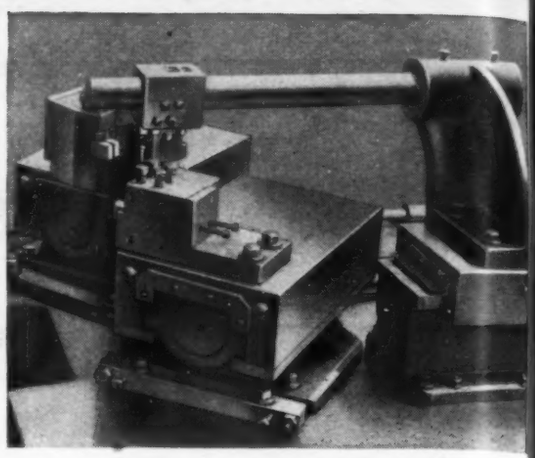
The National Acme Plant at Cleveland—12½ acres of floor space—equipped and staffed for progressive engineering and precision manufacturing.

The NATIONAL ACME COMPANY

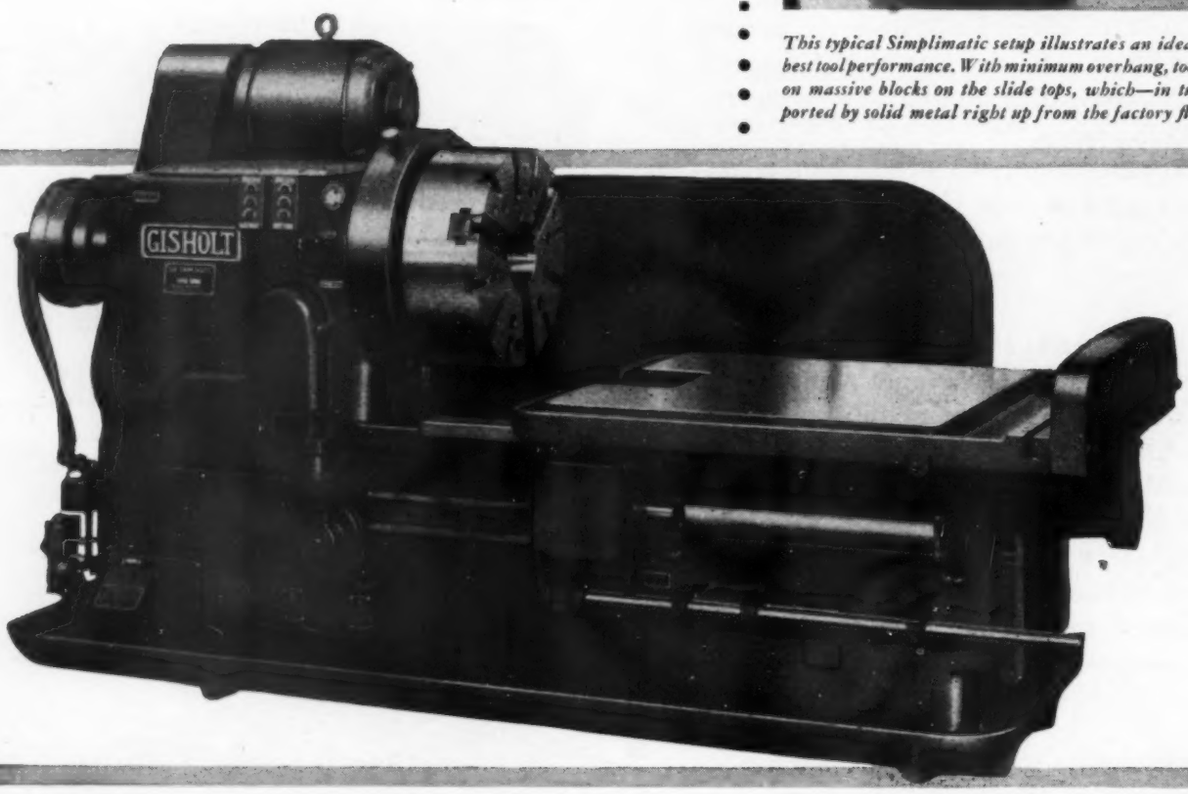
170 EAST 131st STREET • CLEVELAND 8, OHIO

ACME-GRIDLEY BAR AND CHUCKING AUTOMATICS: 1-4-6 AND 8 SPINDLE • HYDRAULIC THREAD ROLLING MACHINES AUTOMATIC THREADING DIES AND TAPS • THE CHRONOLOG LIMIT, MOTOR STARTER AND CONTROL STATION SWITCHES SOLENOIDS • CENTRIFUGES • CONTRACT MANUFACTURING

WHY tooling is more effective on the GISHOLT SIMPLIMATIC

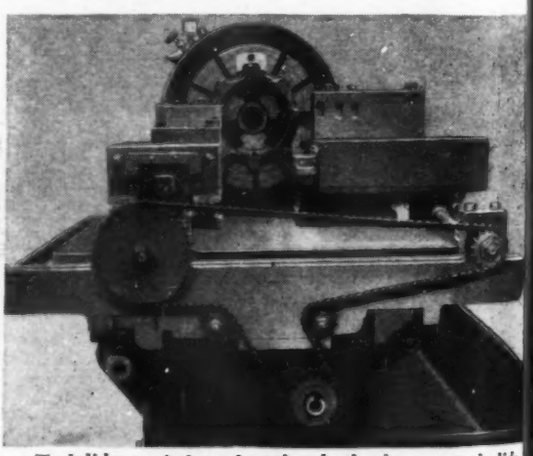


This typical Simplimatic setup illustrates an ideal condition for best tool performance. With minimum overhang, tools are mounted on massive blocks on the slide tops, which—in turn— are supported by solid metal right up from the factory floor.



You can always place tools to best advantage on the large horizontal platen table of the Simplimatic. You can individualize the machine with a slide arrangement most suitable for the specific job, and have an ideal condition for each tool as to overhang, order of engagement, feed, dwell and retract.

Moreover, you have utmost rigidity for tool support. With slides as well as the heavy platen table resting on and against hardened and ground steel ways and gibs, there's no vibration or chatter. High-speed production, within close limits of accuracy, makes the Simplimatic the wise selection for large volume machining. Write for literature.



Tool slides are independent of each other because each slide is individually cammed. Slide top engages cam directly, eliminating all bars, beams, pivots or levers between the driving cam and the cutting tool. Pick-off gears and sprockets provide wide choice of feeds.

GISHOLT MACHINE COMPANY
1201 East Washington Avenue • Madison 3, Wisconsin

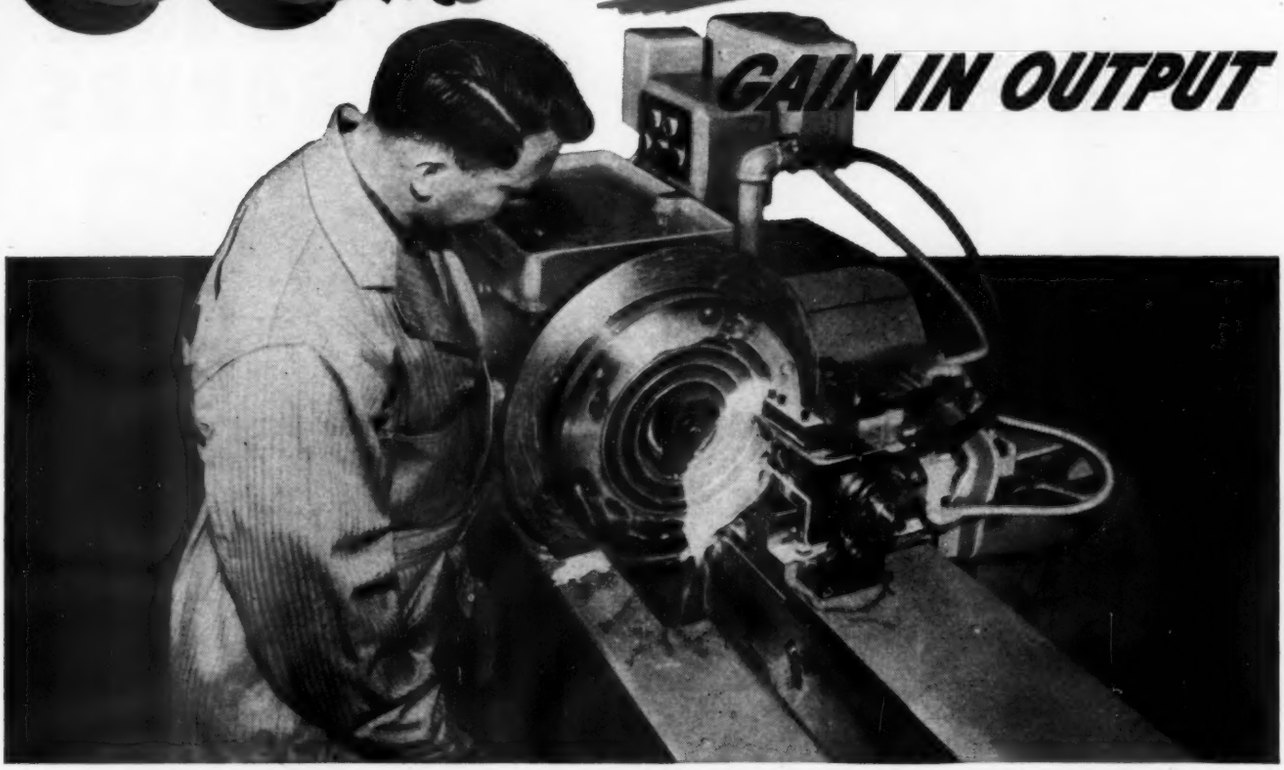
GISHOLT

Look Ahead . . . Keep Ahead . . .
With Gisholt Improvements
In Metal Turning

TURRET LATHES • AUTOMATIC LATHES • SUPERFINISHERS • BALANCERS • SPECIAL MACHIN

66% Extra

GAIN IN OUTPUT



. . . when this automatic lathe was THY-MO-TROL equipped

Here's another striking example of the production gains that can result from the partnership of a modern automatic tool and G-E Thy-mo-trol drive.

To speed the cutting of a groove (.0065 in. wide, .0070 in. deep) on a cartridge wheel, a metal-working plant first shifted the work from an older type machine to a modern Sundstrand automatic lathe with special tooling. As then equipped with a two-speed, 2-to-1 ratio motor drive, the output rate of the new lathe was three per hour.

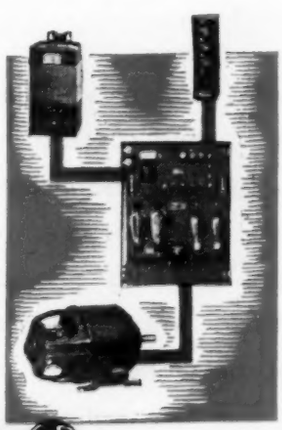
Later, with a change to electronic, stepless speed control of the lathe instead of the two-speed drive, an increase to five pieces per hour was obtained—a 66 per cent *extra* gain, thanks entirely to Thy-mo-trol.

Develops Full Potential of Good Tools

On new machines which are the pride of leading machine-tool designers, G-E Thy-mo-trol drive gives the precision control of speed and torque that's needed to get the most out of all the other advanced features. It provides rapid, controlled-current acceleration and dynamic braking. Speeds can be preset on a small dial that's part of the push-button station. Yet the drive operates from an ordinary a-c power source.

A Complete Drive

Standard Thy-mo-trol drives are available from 1/8 to 25 horsepower. And larger sizes can be furnished. Four compact units—d-c motor, electronic panel, power transformer, and control station—make up the complete drive. For full information, call your local G-E representative. *Apparatus Dept., General Electric Company, Schenectady 5, N. Y.*



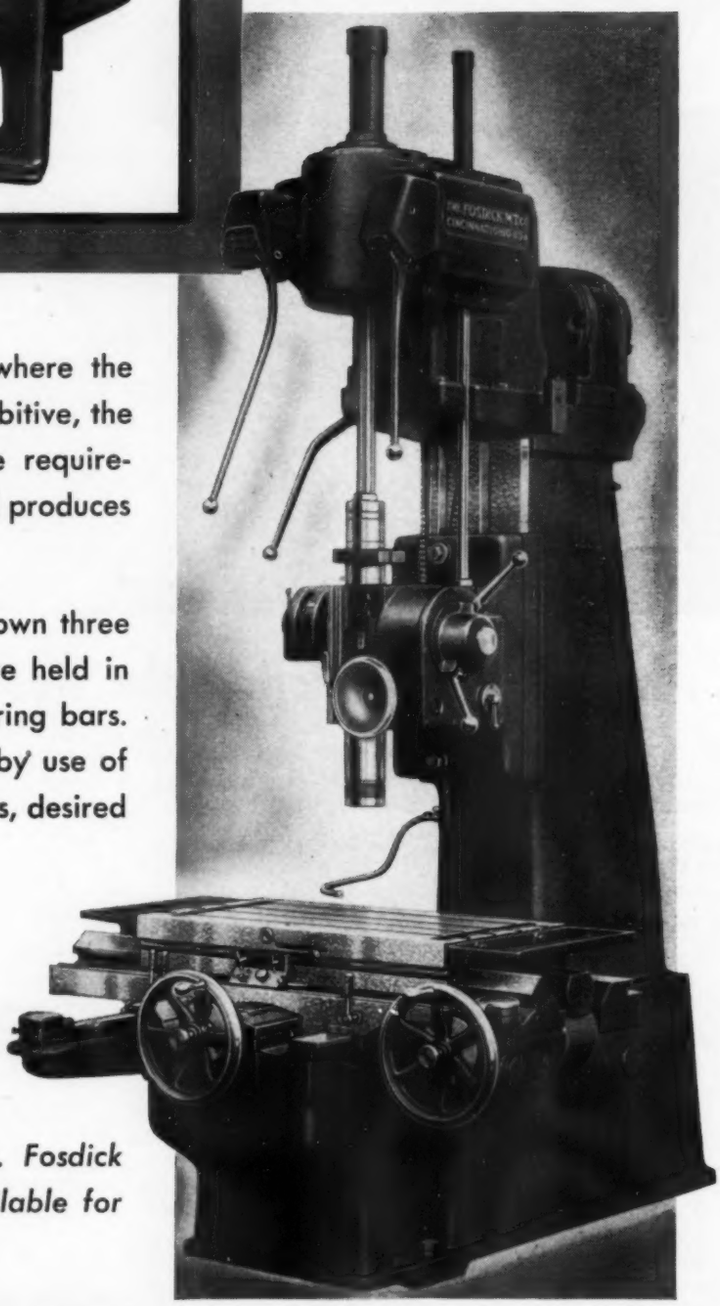
THY-MO-TROL DRIVE

GENERAL ELECTRIC

676-198-5800

JOBS LIKE THIS COST LESS WHEN HANDLED ON

FOSDICK
JIG BORERS



● On precision work, in small lots where the cost of jigs and fixtures would be prohibitive, the Fosdick Jig Borer maintains tolerance requirements—meets production demands and produces the job at a minimum cost.

For example, on a job like the one shown three sets of holes of different diameters are held in perfect alignment by using piloted boring bars. Extreme accuracy can be maintained by use of measuring rods and dial indicators. Thus, desired results are obtained at minimum cost.

Your work may be different both in shape and specifications but if it requires close adherence to tolerances and quantities are too small to warrant building jigs or fixtures you should investigate a Fosdick Jig Borer. *Fosdick Jig Borer bulletin J. B. A. is also available for further information.*

FOSDICK MACHINE TOOL COMPANY
CINCINNATI 23, ··· OHIO

"BECAUSE MORSE TOOLS HOLD UP SO WELL, REPLACEMENTS ARE HELD DOWN TO A MINIMUM"

AS ALWAYS—THROUGH DISTRIBUTORS

Morse Tools make a substantial contribution to production efficiency and economy. For significant savings and better quality work, use Morse Tools.

MORSE THERE IS A DIFFERENCE **TWIST DRILL AND MACHINE COMPANY**
NEW BEDFORD, MASS., U. S. A.

NEW YORK STORE: 130 LAFAYETTE ST. • CHICAGO STORE: 570 WEST RANDOLPH ST. • SAN FRANCISCO STORE: 1180 FOLSOM ST.

THIS LITTLE *Wheel* MAKES A BIG DIFFERENCE IN PRODUCTION

It's the Gisholt Hydraulic Speed Selector.

Through this one dial type control, the turret lathe operator can instantly shift to any one of 12 spindle speeds without stopping the spindle or releasing the main drive clutch. This means that no time is wasted in shifting gears —no calculations from cutting speed to spindle speed are necessary. When the job is set up and ideal machining speeds determined, with reference to the diameter of the work, the operator can pre-set the Speed Selector for each step in the machining process, merely touching a trip to effect each successive change.

Instant in response and power-operated, the Gisholt Hydraulic Speed Selector not only saves time between cuts but also increases production by making it simple for the operator to use the most efficient speed for each cut. It is available on all sizes of Gisholt Saddle Type and Ram Type Turret Lathes.

THE GISHOLT HYDRAULIC SPEED SELECTOR can be used in two ways: DIRECT or PRESET. Thus the operator can select each speed as desired by turning the wheel, or he can select the speed in advance of the change. Ask for full information.

LOOK AHEAD... KEEP AHEAD... WITH GISHOLT IMPROVEMENTS IN METAL TURNING

GISHOLT MACHINE COMPANY

1201 East Washington Avenue, Madison 3, Wisconsin

TURRET LATHES • AUTOMATIC LATHES • SUPERFINISHERS • BALANCERS • SPECIAL MACHINES

NEW WELDING CONTROL

New CR7503-C110 welding control. Inset shows the master control station, which can be removed for mounting on the welding machine.

Accurate timing • Smooth heat adjustment • Fully electronic

As this control is of the synchronous-precision type, it provides the accurate repetitive timing, even with instantaneous or sustained line-voltage variations, so essential to highest-quality welding. This control, the most versatile of all G-E resistance-welding controls, is not only ideal for the types of work given below, but it can also be used where it is desirable to do all three types of work on one machine.

Spot or Pulsation Welding

This control is particularly well suited for these two types of welding because of its wide timing range. It can be used in the welding of thin-gage metals where consistent timing of as low as one or two cycles may be required, in the welding of heavy-gage metals or in projection welding where pulsation welding may be required, or in special welding applications where pulsation welding may be required with a minimum heat and cool time of one or two cycles.

The timing range in spot welding is from 1 to 30 cycles.*

In pulsation welding, heat and cool time, are independently adjustable from 1 to 30 cycles*, and the impulse-counting circuit is adjustable from 1 to 15 impulses—independent of heat or cool time settings.
*When used on a 60-cycle power supply.

Seam Welding

Good seam welding is possible with this control because the accurate timing circuit and the independent adjustment of heat and cool time (in complete-cycle steps) eliminate timing variations and transient currents. Heat and cool time are independently adjustable from 1 to 30 cycles*.

Heat Control on All 3

Smooth heat adjustment is provided by the phase-shift method of heat control. This eliminates the need for many heat points on the welding transformer. In addition, a voltage- or current-regulating compensator can be added by simple interconnections. Also, this welding control when equipped with a tempering attachment makes possible good results in the spot welding of thin-gage air-hardenable steels.

*When used on a 60-cycle power supply

Send This Coupon for Your Copy of Our New Bulletin

General Electric Company, Section J645-33
Schenectady 5, N. Y.

Please send me a copy of your new bulletin (GEA-4220). I'd like more information about this new welding control.

Name.....

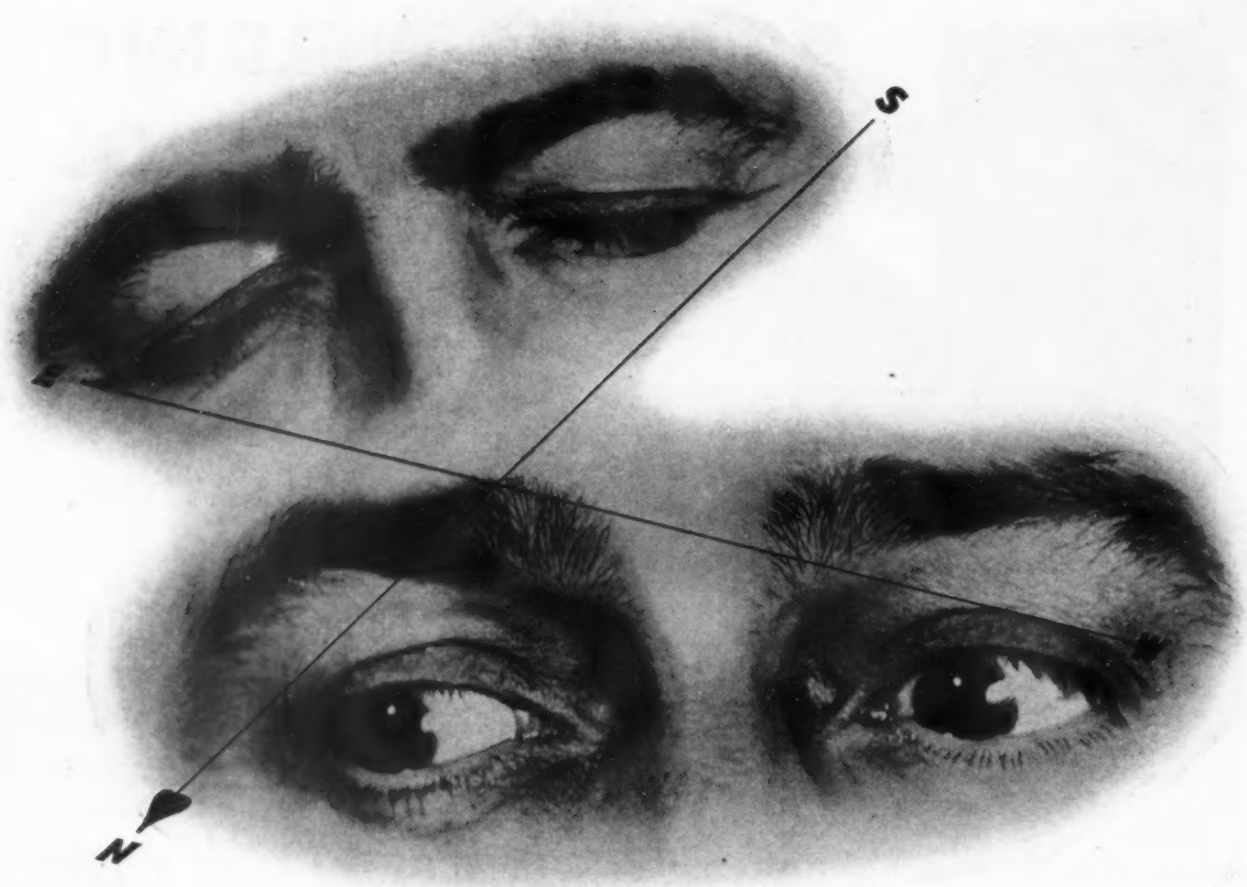
Company.....

Address.....

.....

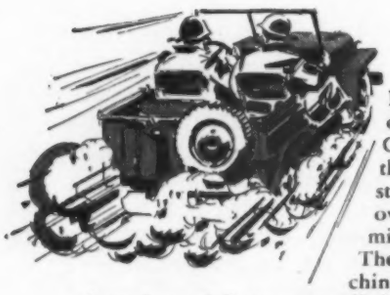
8949

GENERAL ELECTRIC



HOW TO MAKE A MAP

with 4 "Mathematical Eyes" and a Jeep!

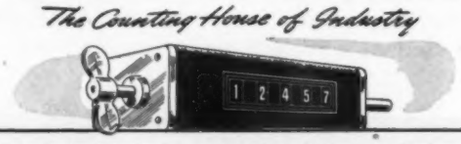


Do it the way Yank jeeps did it in Italy, France and Germany, when they used this equipment to navigate straight to enemy objectives over night-hidden or unfamiliar highways and terrain. They used this uncanny machine called an "odograph" (measurer of distance travelled), which consists of three parts: Magnetic compass with electronic follower . . . plotting unit with map table, tracing pencil, and Veeder-Root Mileage Counters . . . and a power pack operating from storage batteries. This odograph can plot maps from any scale of 1:200,000 to 1:500,000.

Actuated by a beam of light projected into the compass bowl and reflected from a mirror at the center of the compass card, the Veeder-Root mileage counters indicate the distance travelled east and west or north and south of a given starting point. And when two of these "Mathematical Eyes" are counting the miles travelled, say, northeast . . . then the other two eyes are electronically shut and do not count at all. Yet a total is registered of miles travelled in *any* direction. So a set course can be checked . . . or an unmapped course can be mapped . . . by this eerie equipment which needs no information beyond its original bearing, and which can see through walls of steel and dark of night. It always provides an accurate spot-location in land miles, in any direction, from the given starting point. *The map is plotted as you ride!* There are other features which had the Huns talking to themselves. And the peacetime uses you can figure for yourself!

All that remains to be said here is that this is another of the unlimited and unpredictable uses to which men of imagination can put Veeder-Root Counting Devices. These devices can be applied, in ways just as unheard-of as this, to hosts of products now in use or still on the drafting boards. For Veeder-Root Devices can be built-in as integral parts of any product . . . to provide continuous *Count*rol over performance or production . . . or to provide proof of performance-guarantee. So take *Count*sel now with Veeder-Root engineers, and let them open *your* "Mathematical Eyes" to new possibilities for *your* product.

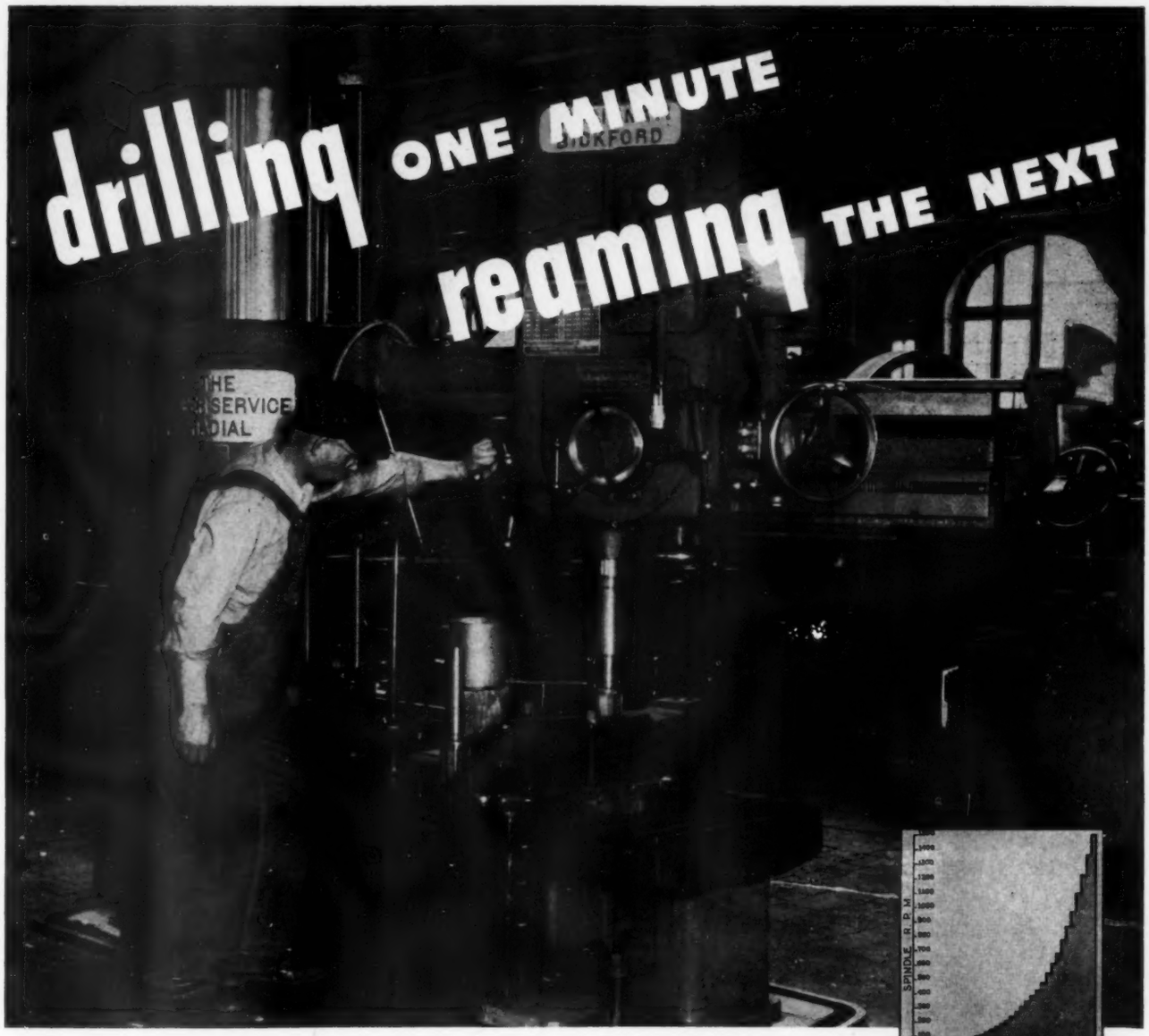
The Counting House of Industry

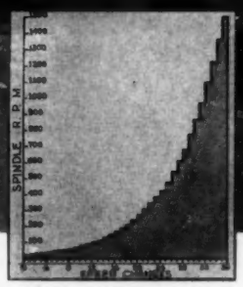


VEEDER-ROOT INC.

HARTFORD 2, CONNECTICUT

In Canada: Veeder-Root of Canada, Ltd., Montreal
In England: Veeder-Root Ltd. (New address on request)





FEED IN THOUSANDTHS AND THREADS PER INCH
DOTTED LINE INDICATES NEUTRAL AND HAND FEED POSITION

POSITION OF FEED CHANGE LEVER									BACK GEAR LEVER
1	2	3	4	5	6	7	8	9	
25	21	17	14	12	10	8½	7	6	→
125 F 5 T	103	87 F 11½ T	71 F 14 T	59	50	42	35	29	←

36 speeds—no gaps or duplication—with only 17 gears.

On maintenance work in railroad shops Cincinnati Bickford Super Service Radials keep the iron horses fit. Boring, tapping, drilling, facing or reaming, their speed and ease of handling keep repair costs down —they have the power, and the correct speeds and feeds for every job.

Write for detailed Bulletin R-24A.

See our condensed catalog in Sweet's File.

● *18 rates of power feeds from .006" to .125" per revolution include standard tap leads.*

RADIAL AND UPRIGHT SUPER C B SERVICE DRILLING MACHINES

Equal Efficiency of Every Unit Makes the Balanced Machine

THE CINCINNATI BICKFORD TOOL CO. **Cincinnati 9. Ohio U.S.A.**

MORRIS
MOR-SPEED
Production Machine
ON THE JOB

● Here a Morris Mor-Speed High Production Machine is drilling refrigerator parts at the plant of a prominent manufacturer.

You will note that in addition to the vertical holes being drilled two side heads handle horizontal holes in the work. Also push button controls are used to handle all functions of the machine so that operator has merely to load the machine and start it. Automatic trips take care of feed and return of the head.

If you have a production job requiring drilling, reaming, tapping or similar operations consult Morris—they have the "know how", the engineering experience, and the facilities to help you get greater production at lower costs.

Builders of MOR-SPEED Radials

The MORRIS *Machine Tool Co.*

CINCINNATI 3, OHIO

Open Letter to Phil Murray

Dear Phil:

Your CIO unions have had a heady time of it lately throwing their weight around. They now are settling for far less than the 30% originally demanded, after having kept the country in an uproar and many of our manufacturing industries stagnant for weeks.

Despite settlements now made, disturbing rumors of impending jurisdictional squabbles between unions are being circulated. And people are asking, "How long will labor be satisfied with what it has? Are we in for another paralyzing spectacle later on in the year similar to the one we've just gone through?"

You, Phil, are in the best position to answer these questions. But before you do, I'd like to point out a little of the thinking that some of us on the sidelines have been doing lately.

Your steel workers and electrical workers and automobile workers aren't the only ones alarmed about the rising cost of living. Farmers, professional people, in fact, all classes are just as much concerned about it as you are, because it hits their pocketbooks too.

And that brings me to the main point of this letter. You don't want inflation. Your members don't want it. Farmers don't want it. We in the publishing field don't want it. Nobody wants it.

The trouble is that, like it or not, inflation is here. We already have some of it, and are due for more of it unless things change, including the attitude of the CIO.

There is one action that your union can take that will do more than anything else to help head off runaway inflation—that is for each man to be on the job every working day turning out materials and goods, putting his heart into his job, and doing a day's work for a day's pay.

The only safeguard against more inflation, many of us believe, is for America to produce the greatest volume of goods in the shortest time.

There still is plenty of "hot" money around, burning a hole in people's pockets. They want to spend it, but there aren't enough things to buy with it. The trouble then is that if you are set on getting something, you'll pay any price.

Just as soon as goods are available again in volume, pressure on prices will ease. Competition will tend to work against inflation. Lower prices will be used as a bait to catch more customers.

Thus the biggest contribution that your men can make is to get busy and stay busy on your factory jobs. Picket lines will not hold back inflation.

That leads me to one other point. Prices of things that you and I buy from day to day cannot go down or stay where they are if production costs go up. What we must have is lower unit costs.

One of the biggest elements in determining unit costs is the amount of production per worker per day. Lately too few workers have felt that they had any obligation to turn in a good day's work.

You could help a great deal, Phil, by getting across to your own people the fact that how much bread, meat and potatoes they buy for a dollar is partly determined by how much work they do.

In closing, Phil, I just want to say that all of us are hoping for prosperity. It is impossible to attain prosperity, as you know, unless every group is willing to do its part. We'd feel happier if we believed that we could count on your unions to do their part. How about it?

Sincerely

Burnham Finney

THE CINCINNATI SHAPER CO.

CINCINNATI 25, OHIO U.S.A.

SHAPERS · SHEARS · BRAKES

Paid for itself 4 times!

This Cincinnati Press Brake bending ends on hopper chutes in a railroad shop paid its cost four times in three years.

Cincinnati Press Brakes are versatile and busy machines, as the same machine will punch, bend, form or corrugate both ferrous and non-ferrous metals.

Modern in design, modern in performance, and modern in speed and accuracy, they are profitable tools.

Write for instructive brake catalog B-2. It illustrates many press brake applications.

Is Craft Pride Dead —Or Only Dying?

War-shortened training periods and "de-skilling" of operations, unbalance in income for skilled and unskilled workers, seniority and reduction of permissible apprentices are stifling factors

BY WHITING WILLIAMS

"CAN YOU GIVE me two good reasons," a skilled but hourly rated mechanic recently asked his superior in charge of maintenance, "why I shouldn't get me a nice fat piecework job by trading my kit of fine tools for a grade-A broom?"

Now that similar queries are being put by so many workers, the ordinary, non-industrial citizens can hardly be blamed if they appear convinced that, if the old-fashioned pride of craft and of job isn't already laid out on the morgue's cold slab, it is at least dated up for the undertaker. Whether or not these observers are right, it must be admitted that this particular patient has lately been taking a terrific beating at the hands, not of "persons unknown" but, instead, of such conspicuous assailants as these:

". . . de-skilled into such simple components as permitted Pearl or Phyllis to take over . . ."

1. As in all modern wars, the recent super-demand for hurry-up munitions put the wages of many producers whose output can be measured away up and out of line with those more skilled and responsible artisans whose daily tasks are too various and too unforeseeable to favor any yardstick.

2. The same super-pressure for front-line items demanded that a big proportion of machine and similar operations be "de-skilled" down into such simple components as permitted inexperienced Pearl or Phyllis to take over "old Pete's" lathe or press.

3. Long before the War, mass-production's assembly lines broke down into small pieces and distributed to a series of special machines and operations, the over-all "know-how" once furnished only by the trained craftsman.

4. During recent years the organized trades have put constantly stricter and stricter limits upon the permissible number of apprentices.

5. In the same effort at job-protection, the seniority clauses of most labor contracts have lately made smaller and smaller the freedom, opportunity and other rewards formerly enjoyed by the man of skill. So much so that Matt Smith, head of the Mechanics Education Society, used to call seniority the "Road to Serfdom" because it made everybody the slave of one single employer. Unfortunately, when he later began to organize the less-skilled, he apparently became less troubled by such difficulties as lately caused a tool-designer friend of mine to complain:

"Every employer I saw told me he needed me and hoped I could start next morning. But, in every case, his labor leaders said I'd have to start, of course, at the bottom of the list!"

6. The newer CIO-type or industrial unions (lately abetted by the Government Labor Boards) have, by raising bottom rates and "freezing" the upper ones, regularly sought to lessen all those differentials of pay

". . . by raising bottom rates and freezing upper ones . . ."

and perquisite by which the expert once measured his proper pre-eminence above the untrained laborer. In the case of too many of these unions, these attacks on both differentials and on job-opportunity have been part of a long-term Leftish effort to build a "Working Class" for waging a successful class conflict against the "enemy" employer. Unfortunately, this effort has, in recent years, enjoyed Government support.

". . . my fellow pick-and-shovellers saw me with my new tools of wrench and oil-can, they chorused congratulations . . ."

7. More and more, these industrial and also the older craft or trades unions have combined to limit output and generally to insist on "more pay for less work." At the same time, demands have increased for various varieties of "feather-bed" pay for work not done at all.

8. More recently, political pressure has been represented to the worker as a tool immensely more effective for securing higher wages than any amount of competency on the job itself.

9. Most recent of all is the current demand that employees be remunerated according, not to their own performance, but, instead, according to their employer's past or prospective profits.

10. In support of all the above, the Government appears to have decided that the daily job is nothing more creative or significant than a handy device for distributing "purchasing power" and thus keeping money in circulation. According to this, the higher the pay and the less the work done for it the greater the circulation!

Small wonder that Mr. and Mrs. Public have come to their conviction that nothing could possibly survive these attacks—that to talk any longer of job-pride, to say nothing of craft-pride, is completely silly!

All the same, I am convinced that these observers are wrong. Mostly because they, along with most employers, now take the Labor Leader more seriously than he deserves to be taken, while taking less seriously than he deserves the all-but-voiceless, middle-of-the-road, rank-and-file, wage-earner, whether organized or unorganized.

Why this conviction of mine? Well, in the words constantly used by this fairminded but inarticulate individual wage-earner, "Let me tellya *My* experience!"

On a certain memorable day, my steel-plant boss asked how I'd like to be promoted up out of the cinder-pit gang and go to work under the open-hearth's boss millwright. When he explained that this would increase my pay only two cents an hour I couldn't imagine anybody's getting excited about so small a raise. An hour later I found I was completely wrong. For when my fellow pick-and-shovellers saw me with my new tools of wrench and oil can, they all chorused their congratulations:

"Hey, boodie, where you catch-em job!—Meelwright gang—and no more G-- d--- shovel! Say, you one lucky son of b----!"

Nor was this all. Whereas the first- and second-hands, the aristocrats in charge of the open-hearth "floor," had earlier refused to talk with me as a cinder-pitter, now they suddenly became amazingly chummy!

Job, Not Income

This was only the first of many experiences which revealed a fact everywhere accepted as absolutely basic by every worker, though completely overlooked by virtually all ordinary citizens. This is that his own and his family's right to enjoy a certain level of importance and social standing among their neighbors in the community outside the mine, mill or factory depends less upon the worker's hourly or yearly earnings than upon the particular level of importance assigned his particular job *inside* the plant. Everywhere throughout the world of work, every craft and every task occupies a certain rung on a well-marked ladder or hierarchy of job-importances. Exactly as the bank president is accepted as the social superior of the vice president, so the diemaker takes himself—and is taken by his associates—more seriously than the machinist and, to go farther down the line, by the mere machine-tender and the sweeper. In precisely the same way, the private secretary lords it over the stenographer, the typist and the file clerk.

So my two-cent raise completely failed to indicate the real "social differential" of my new job. This is for the simple reason that everywhere the actual spacing between the job-ladder's rungs represents a complex equation which puts alongside the cents per hour a host of such other factors as the difference in training and experience required, in the kind of work clothes and personal contacts permitted, in the amount of responsibility and chances at promotion, etc., etc. Without exception, every working group devotes endless discussion to the proper weighing of all these various items—until finally the correct spacings are agreed upon: thenceforth no one questions the right of the man who has climbed up a few rungs to enjoy the respect and the kow-towings of all those beneath him on the ladder.

"Where'dya work last, Jack?" Thus, similarly the gang waiting outside the employment office would set about formulating its particular "Who's Who." When all of us had answered, no unskilled laborer so anti-social as to dream of refusing prime rating and the first chance to talk, to the aristocrat who answered, for instance, "Machinist over at the tube mill."

To miss the power of this universal wish to enjoy the recognitions and the status inseparable from the rung just above is to miss one of the strongest forces driving our whole industrial machine. Nor is this limited to the successful or the ambitious

". . . to enjoy the recognitions and the status inseparable from the rung just above . . ."

A Few Suggestions for Reviving Worker Pride

1. Restore your skilled and semi-skilled man's proper peacetime differentials of pay and (equally important) privilege. In this, beware of colliding with the status-rating given by the workers themselves to every job after their years of discussing its component factors.

Make sure, for instance, not to hurt your skilled craftsman's standing and "face" by giving to him, even in the employment office, the same treatment as to your unskilled. Or by mixing in with his skilled and important duties too many unskilled or unimportant ones; these latter greatly reduce his "net" status.

2. Give to each of your foremen, job-setters, gang-leaders, etc., enough importance, standing and credit to keep him from having to save his "face" by "hogging" these from his immediate subordinates. Such hogging is often found to follow when the foreman's pride is stolen from him by *his* superiors—or by Management's super-kowtowing to his departmental steward or committeeman.

3. Take, say, five times as much pains to get the understanding and build the pride of your trained, responsible, higher-rungers as your untrained lower-rungers. Because the standing of the former is acknowledged by the latter, their opinions are accepted as worth five times those of less skilled fellow-workers.

4. In making promotions and transfers, insist upon proper consideration for "Ability and Merit" along with length of service. But, besides making Training easily available to all, reduce to a minimum the area of arbitrary personal judgment by developing all possible impartial and objective yardsticks for measuring intangible qualities.

5. Make sure that your every worker on every level understands the importance of his responsibility and the final use and value of his specific service or product. Your every employee *wants* to take pride in his work for the same reason that you do; if he can't take pride in his work he has a devil of a time taking pride in *himself*.

6. Expect craftsmanly pride in quality work only when you provide Grade-A machines and tools and maintain them constantly in Grade-A condition. No craftsman respects a Management which lacks respect for fine tools.

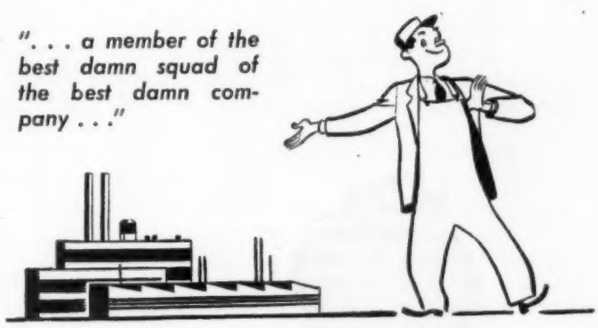
7. Ask all your foremen and other members of Management to "Explain and explain. If you can't explain, explain *why* you can't explain." That goes for lay-offs, promotions, transfers, new products, processes or plans —everything.

8. Don't expect your people to take pride in their jobs unless they can take pride in their Company—by knowing its history, achievements and standing in the industry. (In every community, each company is given a surprisingly definite comparative rating—for surprisingly definite, often surprisingly intangible, reasons. If you haven't a plant publication, use the local newspaper. In both, aim to get the understanding of, among others, your workers' *wives*!)

9. Find or make opportunity to stage and demonstrate company and public appreciation of outstanding individual, group and company performance. (After returning from our ship's champagne launching, we reamers used almost to fight for a chance to use our tools!

10. Recall that all employees, like all soldiers and all the rest of us, delight to believe—and appreciate anything and everybody that helps them to believe—that they are members of the "best damn squad in the best damn company of the best damn army in the whole damn country!"

". . . a member of the best damn squad of the best damn company . . ."



performers. Not one of those who are content to remain on the lower rungs but regularly figures his own importance—bases his right to his own self-respect—upon his daily observation and conviction that all those lucky higher-ups can perform their important tasks only as long as *he* first performs *his!*

"It been plain to see, now be'nt it," so my repair-man buddy in the Rhondda coal mine used to exclaim after we had removed the fallen rocks from the rails and thus permitted the whole outfit to get going again, "they cawn't roon this bloody pit 'thout you and me, cawn they?"

In the railway yard and locomotive cab, in the hot-mill and on the assembly line, out in the oil field or the pump-house—from one end to the other, the entire working world is constantly motivated by the self-respect and the aspiration, the pride, thus generated by the daily job. To be sure, this represents a going scheme of social standings—a caste system. Here amongst us, however, this system is elastic and fluid. It is built, not as in Europe upon a man's being born into a certain static and limited social class, but, instead, upon the completely unlimited development of his individual abilities and capacities. Believe it or not, it is largely because we have thus erected here upon the daily job, instead of on birth, a ladder by which a man may climb to unlimited social recognition and preeminence that we have enjoyed that amazing total of productive ingenuity, initiative and effort which has made America the strongest and richest nation on earth! As a people, we have long taken more pride in our daily work, and given more to it, than has any other for the simple reason that every one of us has had more of both profit and honor to gain from it.

". . . many leaders of Labor and of Politics now seek to displace our traditional system . . ."

This is why I believe that this pride is too deep down within us to be killed by any or all of those ten attacks!

But it must be admitted that today our country is in serious jeopardy. Granted that several of those assaults are only temporary because they are the result of the war's emergency, it still remains true that the majority of them indicate that many leaders of Labor and of Politics now seek to displace our traditional system of personal pride and social esteem built on the individual's productive contribution with one built, instead, on the naked power of his vote. It is because too many of these leaders of both Labor and Politics want to control the ballots of a compact majority group that they preach Class Solidarity and Class Conflict and, to these ends, call upon their every follower to transfer his loyalty away from his job, his employer and his industry and hand it over to his working class and his voting party.

If these purposes succeed—if job loyalty and pride are thus finally to be destroyed—then, beyond all doubt, the power and the glory of our country will soon depart. For no nation can hope to retain either its strength or its level of living once it has been persuaded to give its esteems and recognitions to the allegedly "humanitarian" political distributors of wealth instead of to the allegedly "selfish" industrial *creators* of it.

Whether the attacks of those nefarious assailants have already been too effective to be undone in any near future is now tragically less certain than could be hoped. Luckily, however, the most effective efforts towards the hoped-for undoing are likely to be those made by the person who enjoys contact with his workers in what still constitutes, for the reasons given, the most important part of their daily lives, that is, in their daily work. This person is their employer.

Helpful, therefore, to the end so devoutly to be prayed for by thoughtful citizens may be such suggestions as those displayed in the box on the preceding page.

TIPS for Top Shop Men

28 Know when to yell "Help!" Service and supervisory personnel are paid to help you—use them. Don't be a weak sister and forget you have a brain and a spine of your own, but by the same token, don't be hesitant about asking for help on something too new or too big. A little help when it's needed won't hurt your reputation—and may avoid a lot of trouble later.

29 The best way to teach is by setting a good example. Be sure you are exemplary in conduct, appearance, poise, adaptability, alertness. Remember the old riddle about the relative value to society of the preacher and the doctor: "The preacher preaches while the doctor practices."

30 Brain will best brawn every time in handling workers. Consider the personality of the recipient when you train or discipline him. Don't use a club when words will do a better job. And don't waste your time picking specks out of a rotten apple if you're *sure* he's rotten. It's better to start with a whole apple and do the job right from the beginning.

31 Watch for credit hogs. Encourage suggestions, and give credit where credit is due. Be on the watch for supervisory personnel which "helps" some worker with a good new idea, then insist on a share—or all—of the credit. Watch yourself above all, because if you're a credit hog, suggestions will shrivel.

32 Keep up to date on changes in service departments. Don't be caught wrong on procedures in handling grievances, absentees, control of scrap, etc. If you're behind the times, you'll be behind the 8-ball on everything you try.

33 Always have a second-in-command. It's just as important to have an understudy in a shop as it is in a show. No understudy means no decision in the emergency when you are inevitably away—and no replacement when a better job comes along for you.

Silver Simplifies Shunt Soldering

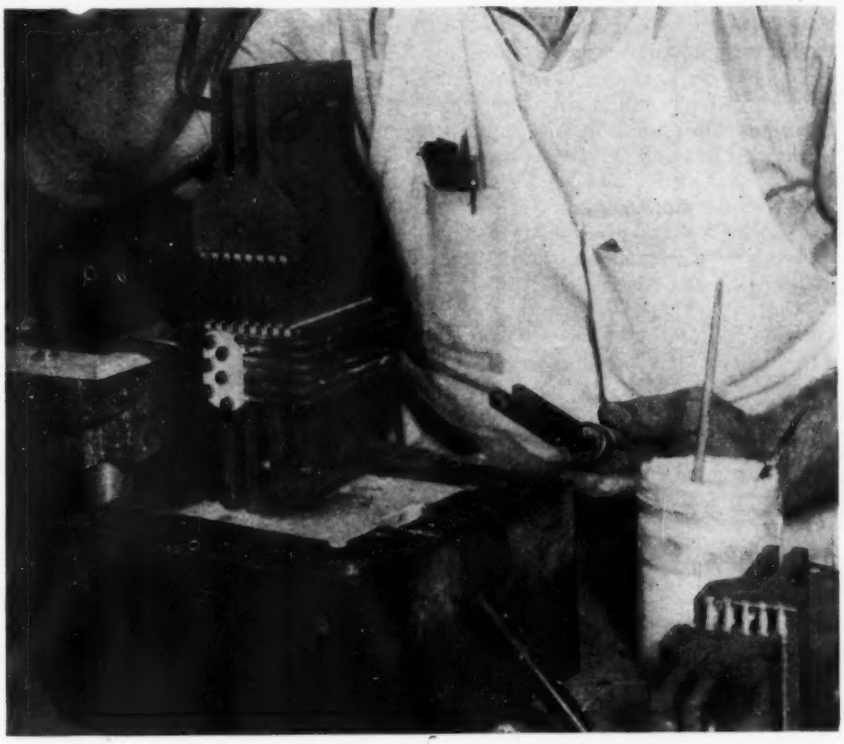
BY U. L. SMITH
AND PAUL MACGAHAN

ASSEMBLING ammeter shunts by soft-soldering resistance strips into slots in the end faces of terminal blocks was a slow process involving heating, cleaning, applying flux and solder; then cooling and filing to improve the appearance. Soldering jobs were often imperfect and were rejected on test. Silver soldering produced a much better joint, but was too slow for volume production.

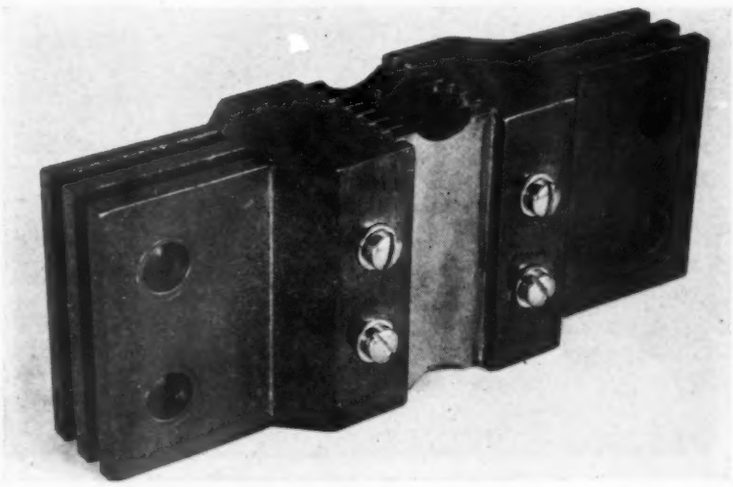
The problem of quantity production was solved with high-frequency induction heating and silver solder. To utilize this method, notches are punched in the ends of the resistance strip. A piece of silver-solder wire of the correct diameter is cut to length and inserted, with the resistance strips, into the slots in the terminal. Terminal blocks and resistance strips are then pressed together by a closing fixture. This pressing serves the double purpose of holding the shunt in position and sealing the ends of the milled slots so the solder will not creep out during heating.

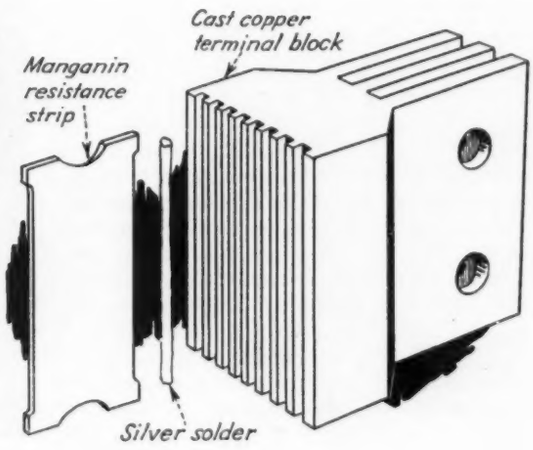
The assembly is placed in the magnetic field of a coil which receives a high-frequency current from the generating outfit. In a few seconds, shunt terminals are heated to the exact temperature to melt the solder. The shunt is then cooled by quenching.

Placing the solder within the slots before heating eliminates hand feeding of the solder and allows it to form definite fillets, between the strips and the terminal joints, by capillary action. Cutting the solder to length and a timer on the induction heater makes this type of soldering automatic in operation and assures a uniform product. One of the advantages gained is the elimination of filing and removal of excess solder, which has always been necessary with the soft-solder process. Silver solder costs more per pound than soft solder, but less material is wasted.



Ammeter shunts consist of two cast-copper terminal blocks slotted to receive eight resistance strips. Resistance strips are end-notched to permit insertion of silver-solder wire. The tab at each end of the notch acts as a dam





When induction coil heat melts the silver solder, capillary action between side-faces of the resistance strips and slots causes the molten liquid to rise and form neat fillets at intersection planes

Power-Feed Attachments Take Wobble

Metalworking applications loom for units developed to improve portable drilling operations on fighter-plane fuselage members

BY E. W. COOPER, TOOL ENGINEER, NORTH AMERICAN AVIATION, INC.

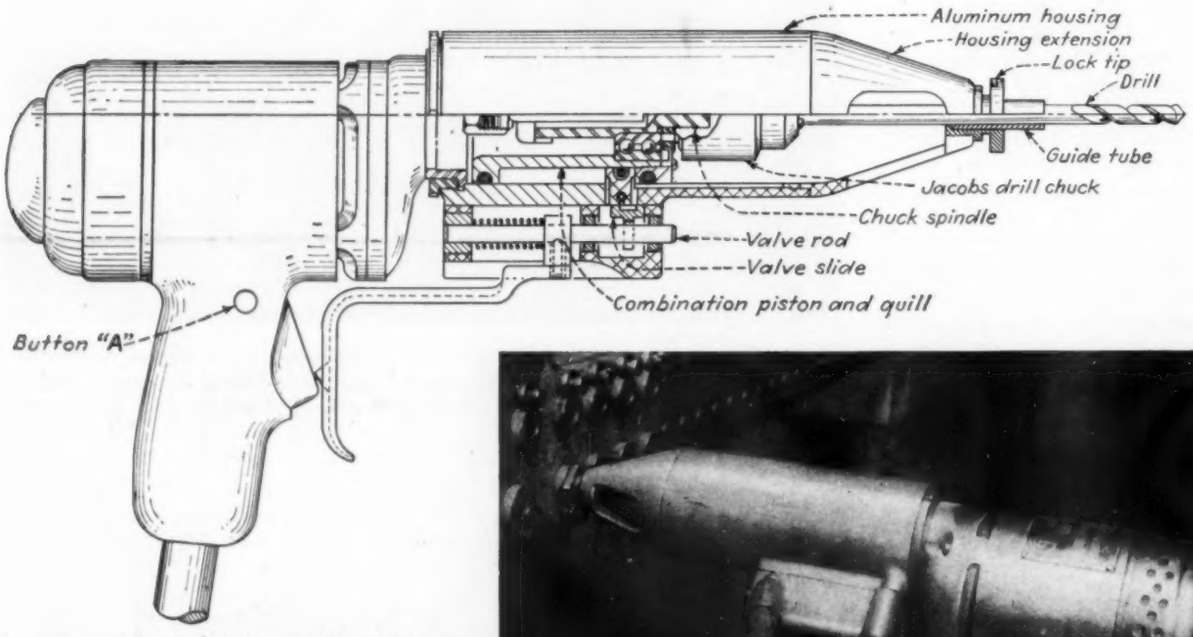
PORTABLE drillpresses made by mounting pneumatic power-feed attachments on portable electric drills have sped production, improved workmanship and reduced fatigue in the California and Texas Divisions of North American Aviation, Inc.

A unit developed at the California plant consists essentially of a commercial ¼-in. capacity portable electric drill, an air-feed cylinder, a combination piston and quill, a ball-bearing-mounted spindle extension, a splined driver, a built-in feed-cylinder operating valve (sliding type), and a commercial Jacobs chuck. There is also a guide tube for accurately centering and locking the drill unit in position on the jig-bushing heads.

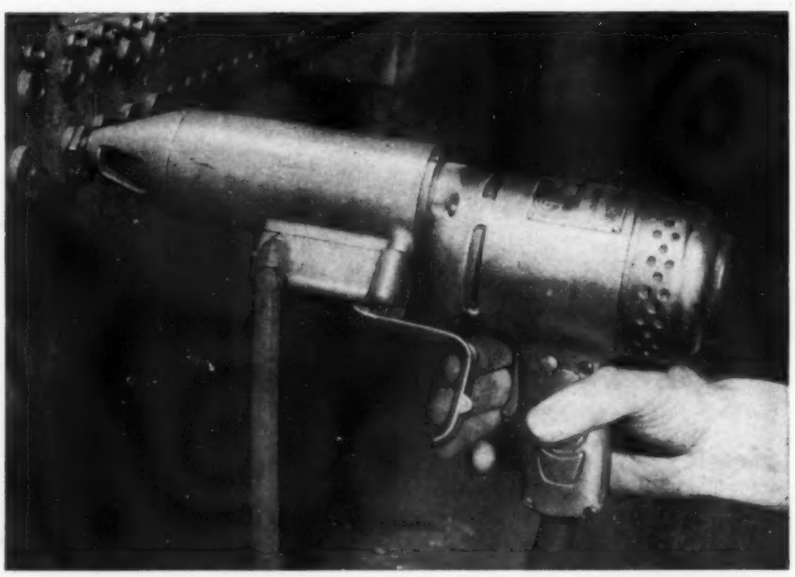
The air-feed cylinder, mounted directly on the forward end of the drilling unit, is an aluminum casting which also serves as the attachment housing. It is made in two sections for ease of manufacture. The rear section, which is the air cylinder proper, is bored out from each end to the valve port wall in the center.

The combination piston and quill, assembled from both ends of the cylinder, forms two air chambers. Backward movement of the flat sliding valve allows air to pass through the port wall into the forward end of the cylinder, causing the piston and quill to move forward. Air behind the piston exhausts through the center of the sliding valve. When the valve handle is released, the spring returns the valve and reverses movement of the piston by passing air into the opposite end of the cylinder. Neoprene O-rings seal the piston and valve.

The piston travels in and out with the piston movement, and is rotated at the same time by the slip-splined

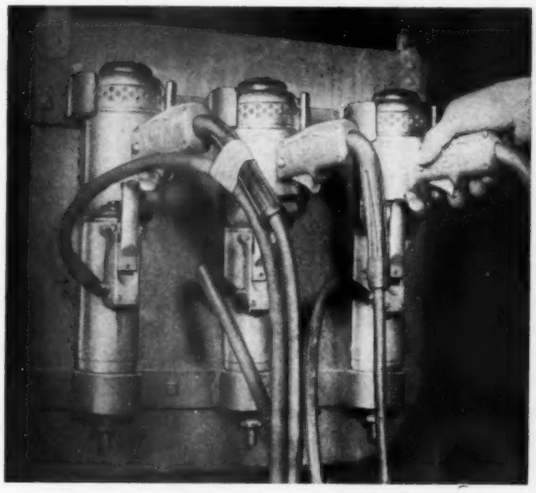


Accuracy of feed and absence from binding is assured by the design of this pneumatic feed unit fitted to a ¼-in. capacity electric drill motor. A hollow piston surrounds the spindle drive shaft. In the forward housing extension is a hardened steel guide tube which is entered into the drill bushing of the jig. The locking tip holding this tube connects under the head of a screw beside the bushing to hold the assembly in position

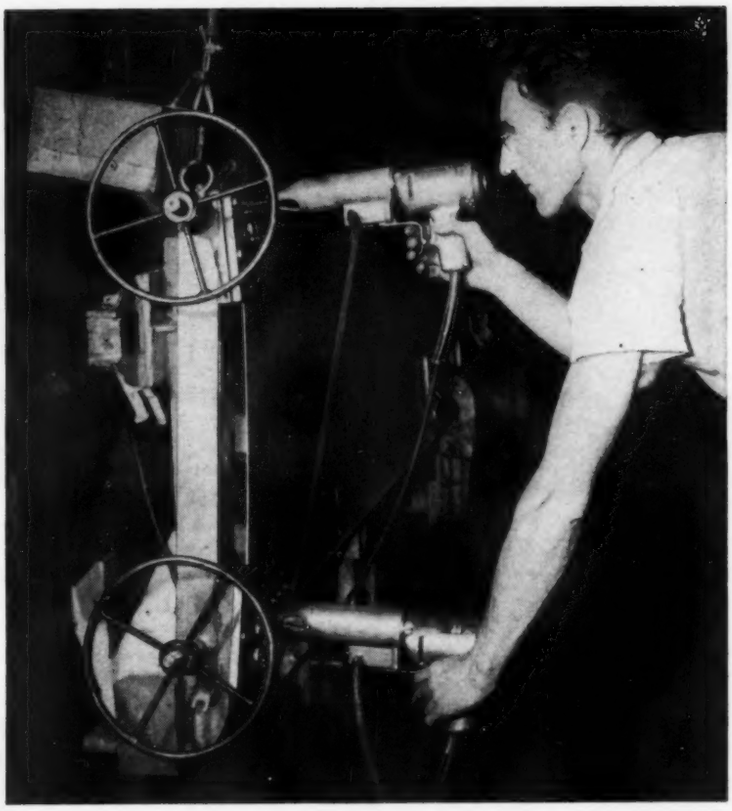


Pneumatic feed is used for drilling an engine mount hole in the end of a fuselage panel for a P-51 *Mustang* plane. As trigger is released, the drill automatically backs out of the hole for cooling and removal of chips

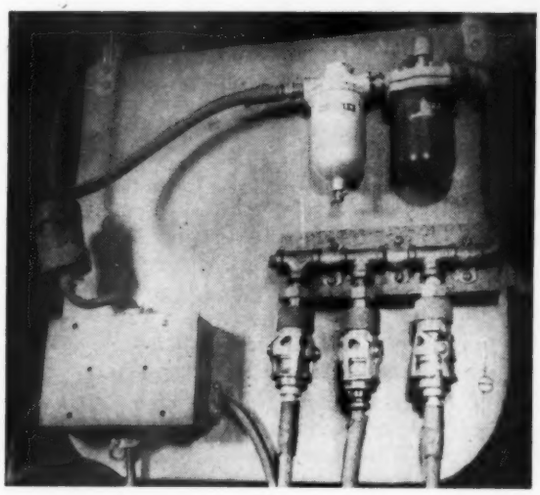
Out of HAND DRILLING



Drills with pneumatic feed units for drilling P-51 fuselage members are supported on special boards suspended from Louden rails. Pneumatic pressure regulators, lubricators and water removers are mounted on the rear of this board (see below)



Two automatic-feed drilling heads here are being used simultaneously. They are fed and retracted from the work alternately to insure adequate clearance of chips and to allow cooling of the twist drills. Highly accurate holes can be drilled in this manner. Location of the holes being drilled must be held within 0.005 in. to insure accurate alignment of the engine mount with the fuselage member



A pneumutic pressure regulator and lubricator and a water remover are mounted on the rear of the drill-support board in the air line connected to the manifold feeding the several drill-feed attachments. Beside this manifold is a junction box for connecting lines to the electric-drill motors

driver fastened to the drilling spindle.

Pulling the valve handle back causes the drill-unit trigger to engage and start rotation as the drill moves forward. When the valve handle is released, the drill stops and is withdrawn automatically. If a separate switch button is pressed, the spindle revolves continuously until shut off. This eliminates starting and stopping drill rotation after each operation.

In some setups, one operator uses two drills in alternating cycles until both holes are drilled through. While one drill returns for cooling and removal of chips, the operator feeds the second drill for a few seconds, then repeats the cycle.

The centering device and locking arrangement are mounted in the forward section of the housing. The guide tube, made of SAE-4130 steel and hardened to 50-55 Rockwell C, is mounted in a steel locking tip threaded into the aluminum housing extension. The locking tip hooks under the head of a screw beside the jig bushing to hold the attachment in position against feed pressure.

Several drills of this type were used on the assembly line for P-51 *Mustang* fuselage members. Advantageous in step drilling, the units were used for engine-mount bolt and rivet holes in the forward ends of members. When not in use, the drills were mounted on a support board suspended from an overhead Louden rail, arranged so the setup could be moved approximately 20 ft. for use on a duplicate set of jigs.

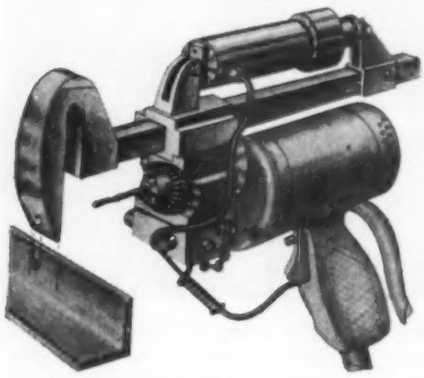
The reverse side of the board carries a water-removal unit and an automatic oil feed and pressure regulator connected to the main air-supply line. Power lines for the drills led from a junction box on the same

board. The pressure regulator for the manifold was usually set at 30-35 psi., proper feed for the aluminum alloys used.

A hook-type pneumatic feed attachment, designed and built by two employees of the Texas Division, proved valuable in drilling holes through relatively thick material forming the outer wing and control-surface assemblies for the plane.

The attachment pulled material and helped support the portable drill against "wobble." When drilling is completed, the attachment automatically releases so the drill can be withdrawn. The attachment is operated by a trigger mounted beside the electric control switch on the handle of a standard ½-in. capacity portable electric drill.

One operation to which the unit was adapted involved the wing nose



This pneumatic-feed attachment pulls the material onto the drill and helps support the motor to prevent wobbling. Operator fatigue is reduced materially. The feed slide bar is connected to the pressure cylinder so adjustments can be made for different thicknesses of work or for different drill lengths

pick-up for the P-51 planes. Approximately 800 holes had to be drilled through skin and spar where stock reached thicknesses of ⅜ in. The operator had to stand, using the drill at about shoulder height. Before the feed attachment was applied, holes in the assembly were not consistently perpendicular to the skin surface because of difficulty in holding the drill steady.

The attachment is a bracket clamped to the spindle-bearing extension on the front motor bracket of the drill and supporting the trigger-operated air valve. The closed end of a small air cylinder is fitted to a clevis atop the bracket. The cylinder provides power for applying pressure against the feed shoe. The shoe is mounted on a long square bar having pinholes for a connection to a bracket which, in turn, is pinned to the piston rod of the air cylinder. This arrangement permits adjustable positioning of the shoe with relation to the drill chuck to suit varying work conditions and to permit the use of drills of different lengths. Release of air pressure in the cylinder causes a spring to return the shoe slide to its open position and thus permits the drill to be withdrawn.

A Small Machine Tool Business Salutes Congress

In the language of Kipling's Tommy Atkins

I went into the R.F.C. to renegotiate,
The conferees they up and said "We're sorry,—but rebate!"
The Board be'ind the bars it laughed ang giggled fit to die,
And outs into the Styx again and to myself sez I:
O it's Excess this, an' Excess that an' "Mister, stand an' pay";
But it's "Thank you, Master Builder," when the band begins to play—
The band begins to play, my boys, the band begins to play,
O' it's "Thank you, Master Builder," when the band begins to play.

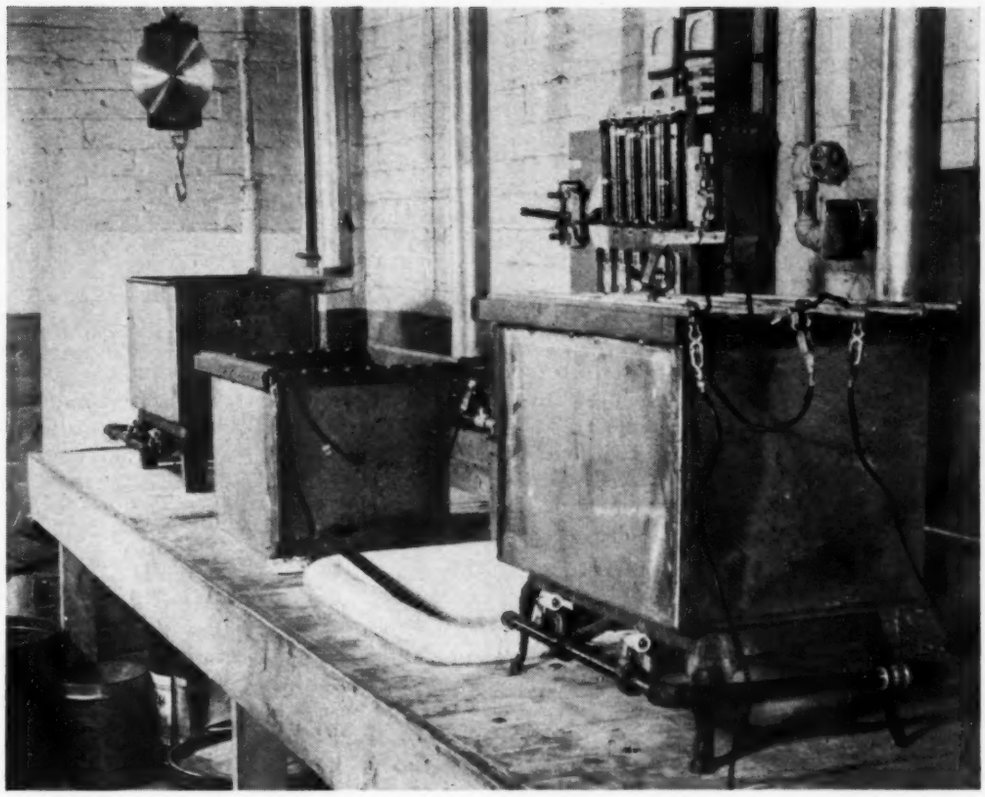
I 'ad a termination just as simple as could be,
They paid a cost-plus buddy 'arf again as much as me;
They disallowed my over'ead and cut in two my tools,
But when it's "More Munitions!" Lord! there isn't any rules!
For it's Surpluses an' Profiteer, an' "Take 'im for a ride";
But it's "Banquets for Tool Builders" when the trooper's on the tide—
The trooper's on the tide, my boys, the trooper's on the tide,
O' it's "Banquets for Tool Builders" when the trooper's on the tide.

Yes makin' mock o' balance sheets that guard the postwar day
Is easy for the bureaucrats that 'aven't got to pay;
An' writin' unilaterals an' boardin' up the court
Is funnier than makin' up a payroll w'at is short.
Then it's Just too late! an' Just too bad! an' "Bankrupt, 'pon my soul!"
But it's "Sinews of Democracy" when drums begin to roll—
The drums begin to roll, my boys, the drums begin to roll,
O it's "Sinews of Democracy" when drums begin to roll.

We aren't no sinewed 'eroes, nor we aren't no blackguards too,
But business men in factories remarkable like you;
An' if sometimes we seem to say the same thing over twice
Why, please an' just forgive us, for the pay-off won't be nice,
While it's Four percent, an' Three percent an' "Wot we say is law!"
But it's "Arsenals of Freedom, sir," when 'Einies want a war—
When 'Einies want a war, my boys, when 'Einies want a war,
O it's "Arsenals of Freedom, sir," when 'Einies want a war.

You talk of 'igher wages an' of cheaper goods an' all:
We'll do our bit to make 'em if you'll treat us rational.
An' don't forget we're oversold, but prove it to our face.
A bit of cash in 'and is not industrial disgrace.
For it's Taxes this an' Taxes that, an' "Make 'im pay, the brute!"
But it's "Genius of Production" when the guns begin to shoot;
An' it's Votes for me an' Votes for you, an' everything you please;
An' Business ain't a bloomin' fool—you bet that Business sees!

THORVALD S. ROSS
Cambridge, Mass.



A start was made with this experimental setup. Gas burners beneath both the oil tank (background) and plating tank (foreground) give the critically controlled temperatures found necessary for best results. Cutters are immersed in the cleaning tank (center) before plating. Reversal of the current in the plating bath provides a cleaning action but it is not effective on cutters with a carbon content over 0.70%. Two standard, 6-volt, 18 - amp., automobile generators wired in parallel and supplied with outside field excitation are the source of plating current

Chromium-Plated Tools Have Longer Life

BY ANDREW A. SPISAK, PROJECT ENGINEER, WARNER & SWASEY COMPANY

A machine-tool manufacturer obtains excellent results through the use of a process that closely controls the thickness of plate

WARNER & SWASEY's decision to apply hard-chromium plating of cutting tools throughout the entire shop was reached upon completion of an exhaustive series of successful tests, extending over many months.

After commercially plated cutting tools failed to give satisfactory results, a broader investigation was undertaken. This included a review of work performed by Axel E. Lundbye, chief engineer of the Crowell-Collier Publishing Company, in searching for a method of prolonging the life of the doctor blades used on his company's presses. Mr. Lundbye successfully developed a carefully controlled special plating process which now bears his name. Because Crowell-Collier offered the use of this method, royalty free, for the duration to manufacturers of war products, Warner & Swasey decided to try it out.

Results were immediately gratifying. Whereas cutting tools plated by the normal commercial process quickly failed by flaking and spalling, Lundbye chromium-plated tools gave unprecedented length of service.

Coupled with a plant-wide survey of the use of chromium-plated tools to determine how widely this development could be put to use, a small experimental plating laboratory was set up. Here it was possible to initiate tests to determine the relative importance of such plating factors as current density, solution temperature and solution strength. These factors depend largely upon the particular installation, as the specifications vary considerably from those recommended, and other divergences have been noted in various plants using the same process.

Regardless of the type of installation used, certain precautions seem mandatory. Extreme cleanliness is, of course, a prerequisite; extra efforts in this direction, even beyond normal procedure, will pay dividends in the quality of plate.

The importance of controlled thickness of chromium deposit cannot be over-emphasized. This is a direct function of time, temperature, and current density, and is "measured" by these factors, as physical measurement of extremely thin deposits, usually less than 0.0001 in., is difficult and impractical for mass-production work.

Proper normalization of the tool to be plated, both before and after plating, is vital to the success of this

process. Normalization before plating assures dimensional stability during treatment, while heat-treatment in an oil bath after plating permits a gradual evolution or dissipation of the free hydrogen ions trapped under the chromium during the plating process. All efforts to use a controlled-atmosphere furnace for this failed, and it appears necessary to exclude *all* gases for satisfactory results.

Surface Failures

Although difficult to confirm, the belief exists that the failure of conventional chromium plating to protect tools results from the presence of hydrogen. It has been thought that rapid heating under pressure of metal removal causes release of hydrogen ions at a rate beyond which they can emerge through the chromium, resulting in an "explosion" of hydrogen which separates the chromium from the base surface. The theory now gaining favor is that the hydrogen participates in a chemical action, perhaps forming acid, which deteriorates the bond between the two metals.

The characteristically brittle nature of chromium is revealed when the thickness of deposit exceeds the desirable minimum. Localized strains resulting from cutting pressures may cause breaks in the coating. Coupled with the unfavorable effect of hydrogen, this condition rapidly leads to flaking of the chromium, which in turn causes a rapid increase in cutting pressure and heat. Complete failure of the tool is the unavoidable result of this progression. Under these conditions, plated tools may be found to give less service than do untreated tools.

Experience has taught that it is economical to replate a cutter after each sharpening, even though the cutter is ground only on clearance areas and not on cutting surfaces. While it is true that such a cutter will usually perform better than one which is not plated at all, the value of plating decreases sharply with each regrind.

Normal procedure is first to regrind the cutter, then to strip the remaining plating, and only then to replate. The plating is stripped by immersing the cutter in the chemical cleaning tank, with the cutter wired as an anode in the electrical circuit. In the production plating department now being installed, stripping will be accomplished by anodizing the cutter in a special chromic acid bath.

In some instances, because of the heat generated by grinding away the hard chromium, it was found necessary to strip the plating prior to resharpening the tool. This prevents damage to the cutter by overheating.

As all tests of chromium-plated cutting tools at Warner & Swasey have been conducted under standard shop-operating conditions, no thoroughly accurate analysis of proper specifications could be made. In some cases, tools were undoubtedly abused by extraordinary conditions, while other runs were completed before ultimate tool life could be determined.

The accompanying table shows the results of this admittedly incomplete survey. Taps, thread chasers, and reamers show a phenomenal improvement, while saws, large drills, lathe and planer tools, and many others show a sufficient prolongation of life to assure unquestionable savings by the use of plating.

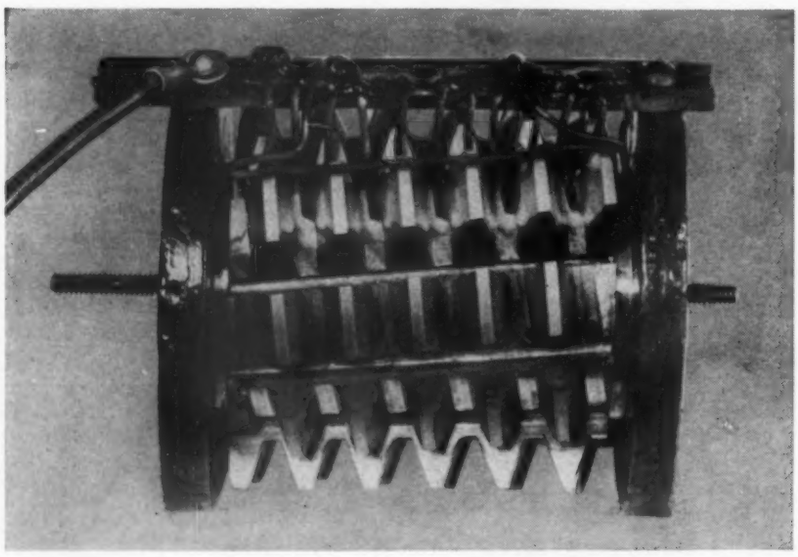
Small drills (up to ¼ in.) do not appear to benefit very much from this treatment. One of the reasons may be that surface speed on small drills is generally too low to permit effective utilization of chromium's unique properties. Moreover, a comparatively large percentage of these delicate tools is destroyed by breakage before the end of their useful life, a condition which would affect any statistical appraisal of results. In view of these facts, and considering the unfavorable ratio of plating cost to original tool cost, small drills are no longer plated.

Plated Tool Life

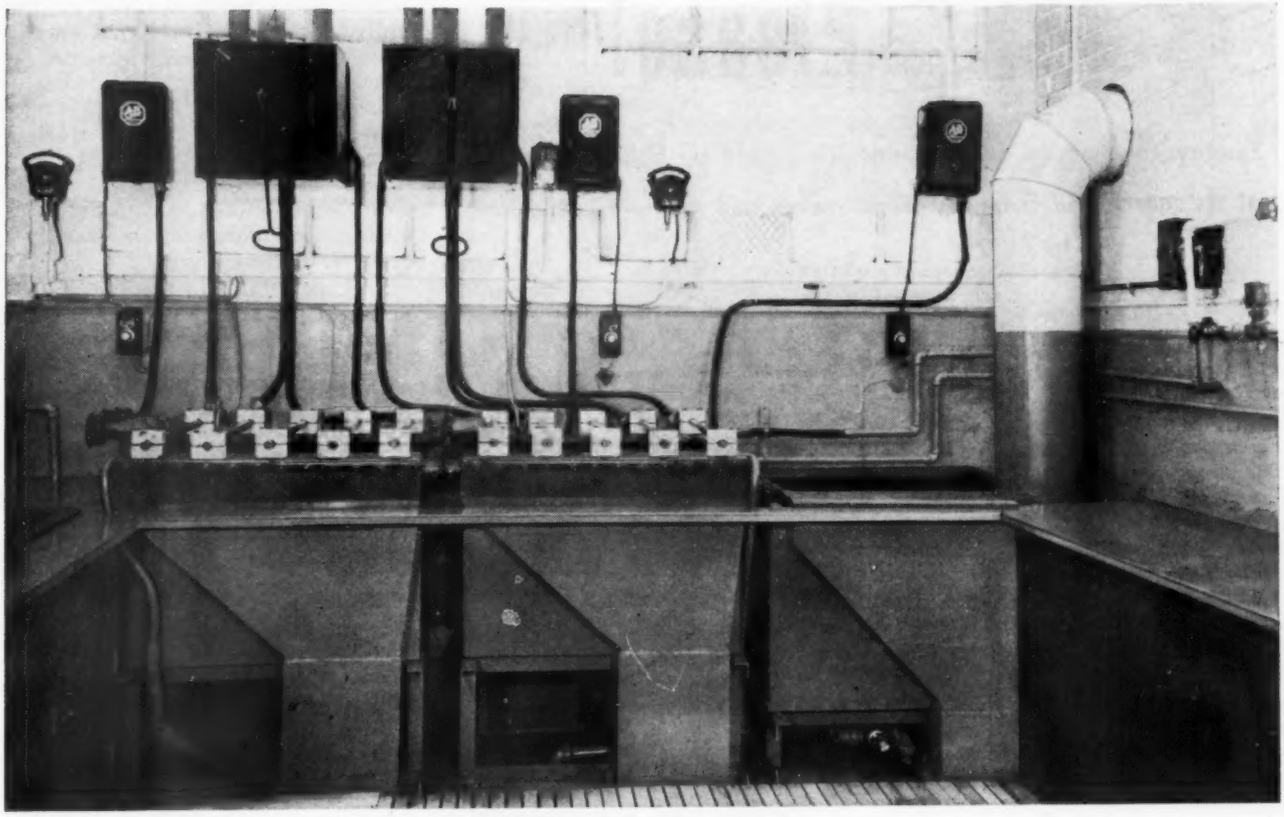
More puzzling is the failure of gear hobs to respond to chromium plating. This problem is still under consideration. Non-uniform deposition of chromium is thought to be the answer. Experiments with special shaped anodes and masks conforming to the general shape of the hobs are being conducted in an effort to improve the situation, as there seems to be no good reason why a properly plated hob should not produce results equivalent to other cutting tools, especially in view of the fine performance of taps and chasers.

In spite of these random failures, the life of a properly plated tool will average 400% of the life of an untreated tool. This obviously represents an incalculable benefit to the manufacturer. The most immediate results are: (1) a lower perishable tool cost and lower inventory, (2) fewer setups, with fewer possibilities for scrap caused by errors in tool settings, and (3) less factory expense in the maintenance of such tools. All represent real reductions in factory cost, particularly in a shop where repeated setups comprise a tangible proportion of machine operating time.

Less apparent are the savings caused by the lowered coefficient of friction on maximum capacity cuts. This means: (1) lower tool loads, (2) more accuracy because of reduced tool deflection, (3) lower tooth loads



This specially shaped anode was developed for plating gear-cutting hobs. Wires fitted closely to the cutting face of the hob teeth permit development of high current density along one axial row of teeth at a time. The hob is rotated within the "cage" until all teeth have been plated uniformly



On the right wall of the new plating room the piping provides an automatic tank-cooling system. The vertical round duct carries away fumes which are drawn into a floor plenum, the blower hung on the roof. The plating tanks straddle the air duct and are electrically heated. Heat is controlled by wall-mounted thermostats. The plating power is from a four-circuit selenium rectifier

and less wear on headstock gears resulting from lowered spindle torque, (4) less strain on the feeding mechanisms, and (5) lower power consumption.

Current Studies

Incomplete data prevent analysis of the value of these factors at this time. However, all aspects of chromium plating are now being studied. This project includes the following:

1. Optimum thickness of chromium plate. Should this thickness vary for different materials being cut and different types of cutters?

2. Reduction of cutting stresses as a result of the lower coefficient of friction.

3. The value of chromium plate on carbide-tipped tools to reduce friction of metal removal.

4. Benefits, if any, resulting from plating clearance angles. Is the cutting surface the only area which should be plated?

5. Variation in performance of different types of plated cutting tools.

6. Effect of chromium plating on maximum surface speeds and feeds of cutters. (All tests to date have been conducted under the operating conditions employed for untreated tools).

Elaborate equipment for measuring cutter life, power consumption, and tool stresses is already available, having been developed for other research now in progress. With this equipment it will be possible to study and evaluate each variable separately.

A larger, more complete, and more flexible plating department has been constructed to replace the small experimental unit. Considerable research remains to be done on plating and heat-treating of cutters, and it is hoped that much valuable information may be obtained from the use of the new equipment. More particularly, its larger capacity will permit the application of chromium plate to tools in many more departments.

The benefits already derived from the process encourage us at Warner & Swasey to recommend chrome-plating of tools to any shop where the volume of work is such as to justify the installation of the necessary plating facilities.

INCREASE IN TOOL LIFE BY PLATING

Type of Tool	Tool Life Increased, Times
Reamer	5 to 9
Tap	4 to 30
Thread Chaser	12 to 22
Saw	4
Core Drill	5
Piloted Counterbore	4
Spherical Cutter	3
Two-lip End Mill	5
Planer Tool Bit	3
Facing Tool Bit	4
Chamfer Tool	6
Boring Cutter	4
Broach Guide	7 to 10
Spline Gage	6
Plug Gage	7
Ring Gage	6
Snap Gage	5

QUIET, Please!

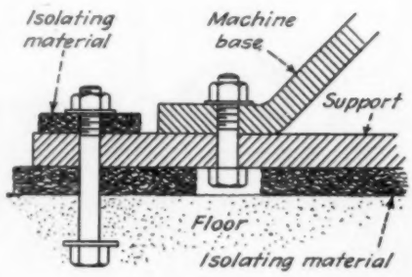
Employee efficiency and machine life upped by killing vibration at its source and trapping sound waves and multiple reflections

BY J. P. CALLAHAN

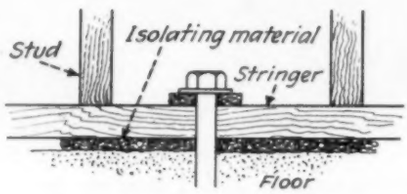
AIR-BORNE sound and structural vibration are two basic forms of noise which lower the morale and productivity of industrial employees. While this type of noise cannot be eliminated, management has found it profitable to minimize this ever-present source of fatigue. Modern sound conditioning can control air-borne noise, and structural vibrations may be lessened by isolation and control of vibrating equipment.

Velocity and radiation of sound waves conform to laws of their own. Radiating in all directions from sound sources, they strike deflecting surfaces and rebound so fast and so often that mingled reflections combine with original sounds as one distorted, prolonged sound.

To the ear, sound registers in decibel intensities of from 0 to 120. This narrow range covers an almost infinite equivalent of relative sound energy units, for relative energy increases on a logarithmic basis. A pneumatic jackhammer drill at 90 decibels may correspond to one billion relative energy units, while a powerful steam whistle at 100 decibels will correspond to ten billion units. Noise in an average machine shop is about 70 decibels.



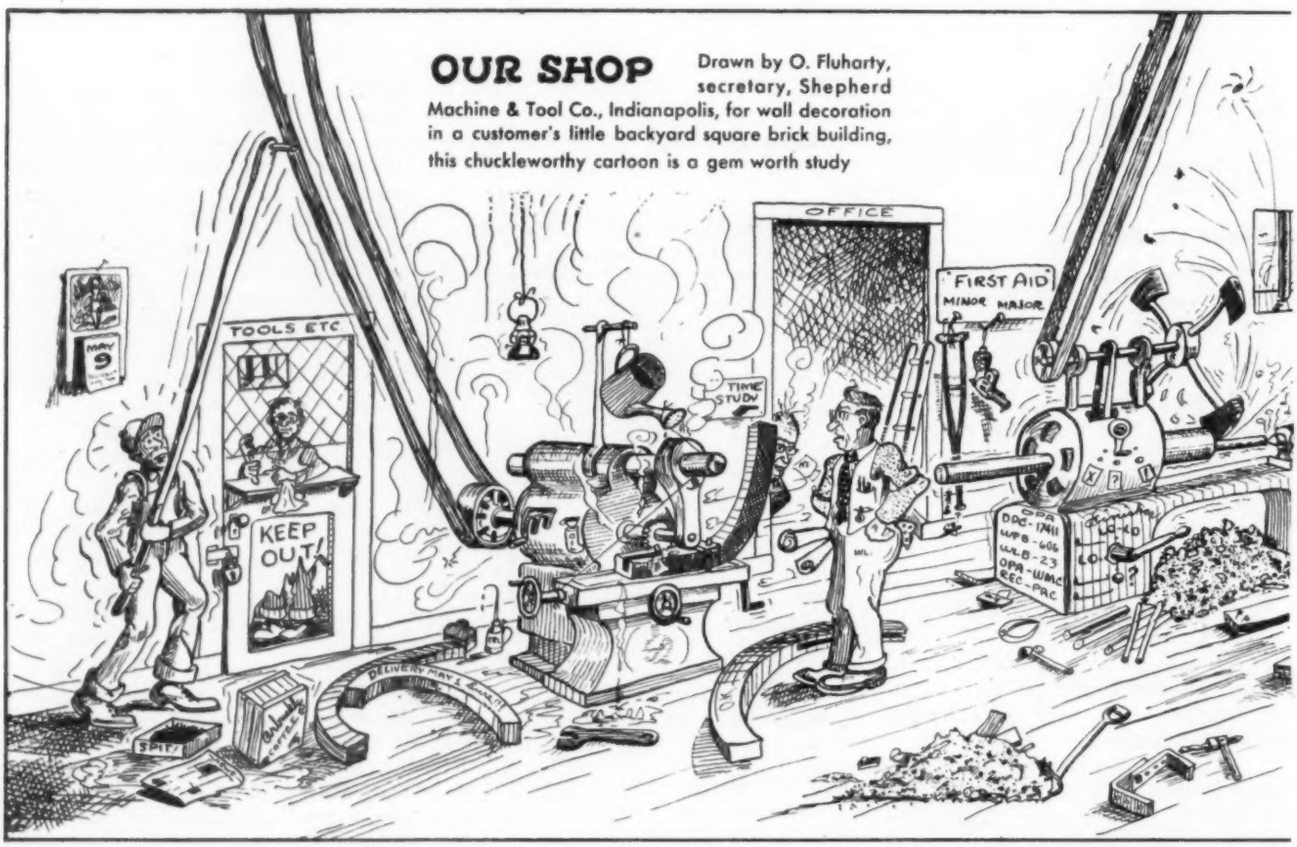
Conventional Machine Isolation



Insulation for a Partition

Lack of ability to distinguish between low and high frequencies, and to rate the degree of sympathetic vibration is peculiar to most sound-measuring instruments so readings should be interpreted by an acoustical engineer. Sound-level meters may be supplemented by readings with electrical sound-analyzers and cathode-ray oscilloscopes which convert sound waves to visible lines on a screen where amplitudes, frequency, phase and shape can be studied accurately. Thus, necessary amount of sound absorption may be determined.

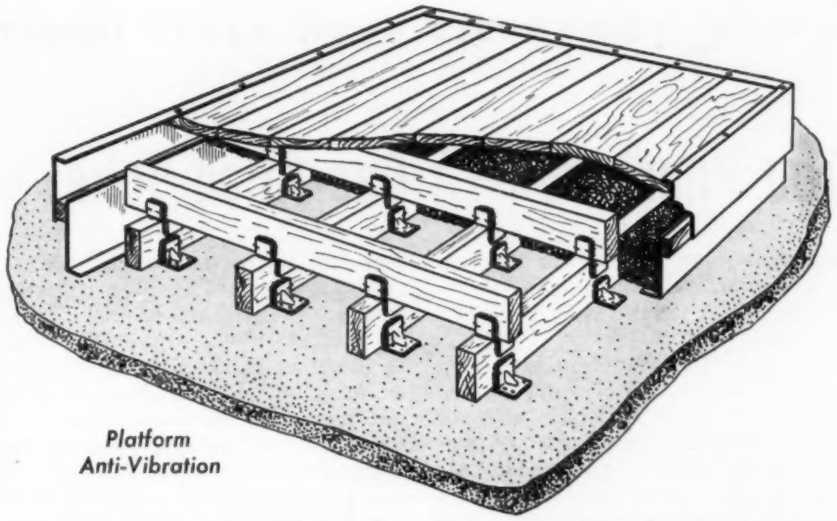
Keystone of a sound-conditioning program is an acoustically treated ceiling, made of cane, mineral tiles, gypsum, baked rock wool or other porous materials. Demountable ceiling units may be installed over any firm existing ceiling. Units attached with cement over wood furring strips trap about 80% of original sound.


OUR SHOP
Drawn by O. Fluharty, secretary, Shepherd Machine & Tool Co., Indianapolis, for wall decoration in a customer's little backyard square brick building, this chuckleworthy cartoon is a gem worth study
OFFICE
FIRST AID
MINOR MAJOR
TOOLS ETC
TIME STUDY
KEEP OUT!
SPIT!

Machinery vibration may be capable of acoustical conduction throughout a building unless controlled. The basic principle is to stop it as near the source as possible. Steel springs, rubber, felt, cork, lead, sand, gravel or asbestos pads subdue vertical, horizontal and torsional vibration. Pads are adjusted in thickness or area to load, speed and frequency. Anti-vibration platforms, adjusted for load capacity, weight distribution and center of gravity, reduce noise and change its character from fans, motors, air compressors, lathes, pumps, motor-generator sets and high-speed apparatus having no solid connections. A common type of base, suitable for small units, has machine foundations floated on a concrete bed, which is poured over a thick layer of absorbent cork. Through bolts are eliminated by bolting the machine to the bed, and bolting the bed through the cork into the floor.

If vibration is caused outside—for example, by trucks or trains passing—it may be necessary to isolate sensitive equipment from the floor, thus inverting normal procedure.

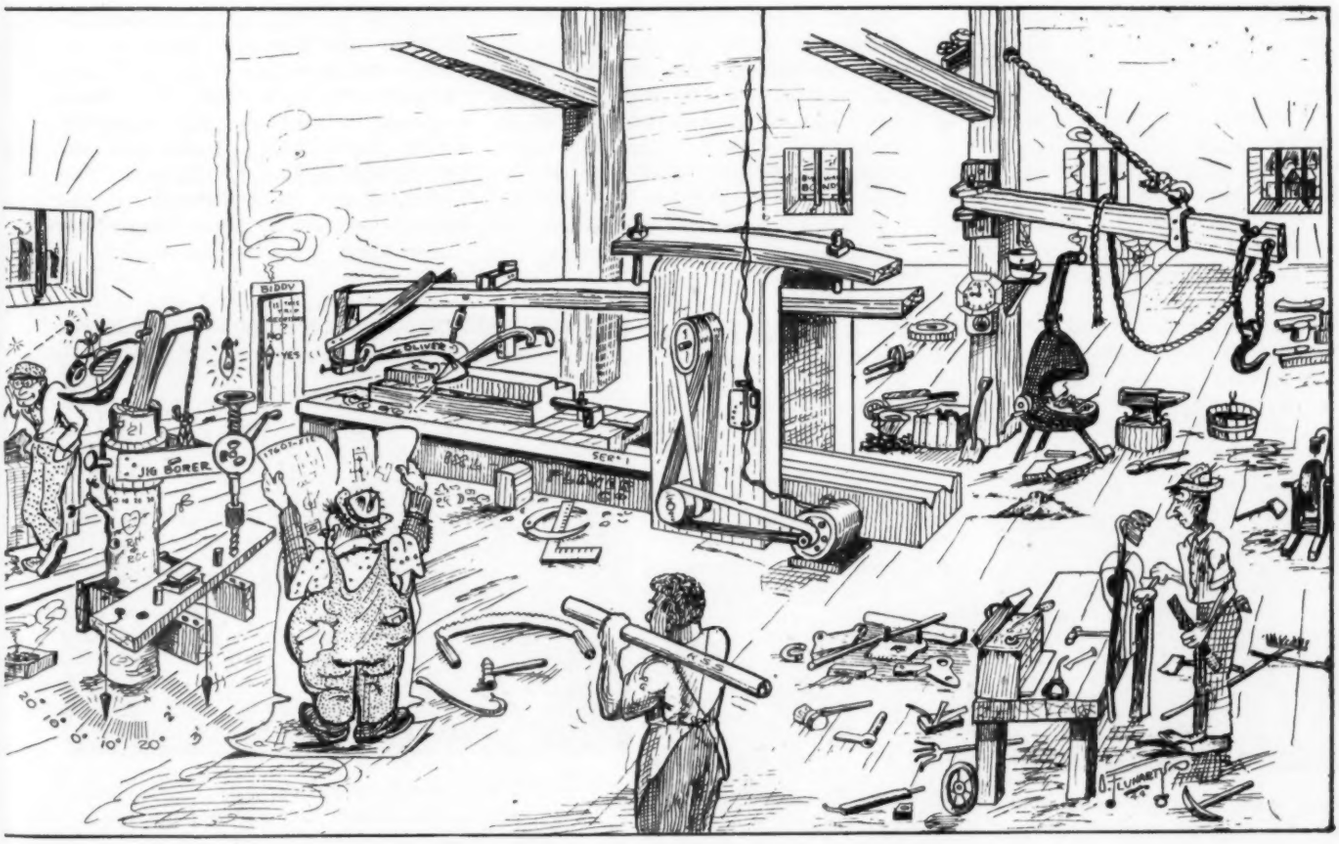
An effective preliminary step is to make sure that acoustical conduction is not provided by piping, radiators, ducts and electric wiring systems. Placing resilient material between pipe flanges and bolts and between piping and hangers lessens vibration and noise transmission. Vibration-creating units, such as the blower of an air-conditioning unit, should be rested on flexible mountings to isolate vibration from the main building structure, as mentioned earlier, because the structure may transmit the vibration to a remote point, converting it to sound.



Platform Anti-Vibration

Increasing the stiffness of metal panels dampens the vibratory movement of the metal, and reduces or avoids resulting hum. The natural frequency of vibration of a panel can be lowered by applying pre-cemented felt or changed by ribbing, dishing or other stiffening. Spot-cemented acoustical sheets for part or full length of ventilating ducts reduces noise- and vibration-transmission.

Continuous floors of reinforced concrete supporting partitions often act like phonographs in transmitting noise and magnifying reverberation through an entire structure. Fluid floor construction in which floor joists and props are separated by insulating or "sleeper" material lessens this.



The Phanotron—A Gas-filled Tube

THE PHANOTRON is used for medium dc. requirements, those chores in industry which require larger currents at lower voltages.

Basically, the phanotron is nothing more or less than a differently shaped kenotron tube into which a small amount of inert gas is inserted. It usually has a heavy-duty cathode. Although phanotrons are most often filled with mercury vapor, gases such as argon and xenon may be used.

We can see the purpose of this gas by recalling the "space charge" in the kenotron, which restricts the flow of electrons. In the gas-filled phanotron, the space charge is eliminated, increasing the flow of electrons—that is, increasing the flow of current through the tube. The process by which the space charge is eliminated is called "ionization."

In order to get a clear picture of ionization, let's try to visualize what happens in the gas-filled area between the cathode and the anode of a phanotron. This area is filled with gas atoms. If the positive voltage between anode and cathode is low, say below eight volts, the gas atoms which are neutral get in the way of the electron stream, forcing the electrons to weave in and out so the current is even less than without the gas. However, if the voltage is great enough, say 10 to 15 volts, the electrons released from the cathode bound toward the anode at higher speeds and crash into the gas atoms.

To understand our next step, let's recall that the atom is neutral as long as its nucleus is balanced by its negatively charged electrons. Sometimes the impact on the gas atom of an electron which has been released from the cathode upsets the balance or neutral status of the gas atom, by knocking out of the gas atom one or more of its negatively charged electrons. The electron, freed from the gas atom, dashes on toward the anode. Having lost a negative electron, the gas atom is no longer neutral, but has become slightly positively charged. The positively charged gas atom is now called a positive "iron" and the process by which it is formed is called "ionization."

What Ionization Does

Ionization dispels the space charge, and thus permits the tube to operate at a low voltage drop between the anode and cathode.

Once ionization starts, the tube is quickly filled with positive ions and flying electrons. This mass of ions and electrons, in the space between the cathode and the anode, is called the plasma. The plasma is a good conductor and readily supplies electrons to the anode as required by load.

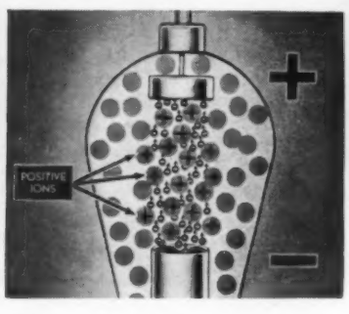
As the anode draws electrons from the plasma, the remaining positive ions cause the plasma to become more positively charged. Thus the more positively charged plasma draws replacing electrons from the cathode. These tend to restore the balance of electrons and ions in the plasma.

As the freed electron flies toward the anode, the ion, being positive, is attracted by an equal pull toward the cathode. Since the ion is many times heavier than the electron, it moves much more slowly. As each positive ion drifts slowly toward the cathode, it consecutively neutralizes the negative effect of hundreds of electrons, helps dispel the space charge, and sends electrons bounding on their way to the anode.

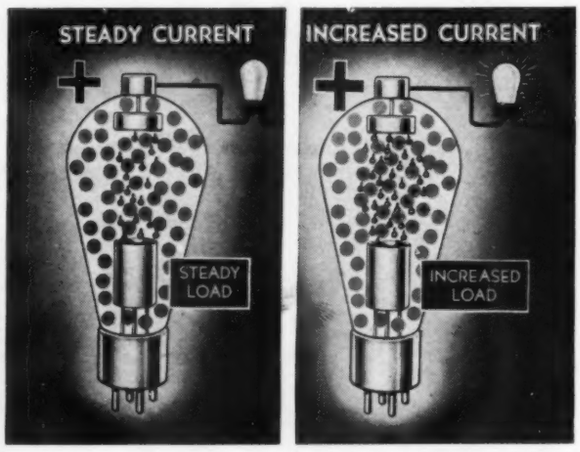
With a steady current flow to a load, the number of ions to electrons remains relatively constant. However, when the load requires an increase in current, the anode draws an increased number of electrons, causing plasma to become even more positive. In replacing this increased electron drain, the plasma now draws more electrons from the cathode and draws them at an increased velocity. The combination of more electrons and greater velocity causes additional ionization. Thus, with an increased number of ions to match the increased number of electrons, the plasma is again restored to an approximate balance. So, only a slight voltage increase in the plasma is needed for a large current increase. Actually, an increase of only a fraction of a volt is needed for a tenfold increase in current.

The phanotrons serve as general-purpose rectifiers for medium dc. power requirements. They are used in supplying current for the lifting magnets on cranes, for magnetic chucks on machine tools, and for self-regulating battery chargers. The kenotron and the phanotron are the basic two-element tubes from which many other tubes are derived.

The dot in the phanotron symbol indicates the presence of gas



Gas atoms by electron bombardment are positively charged

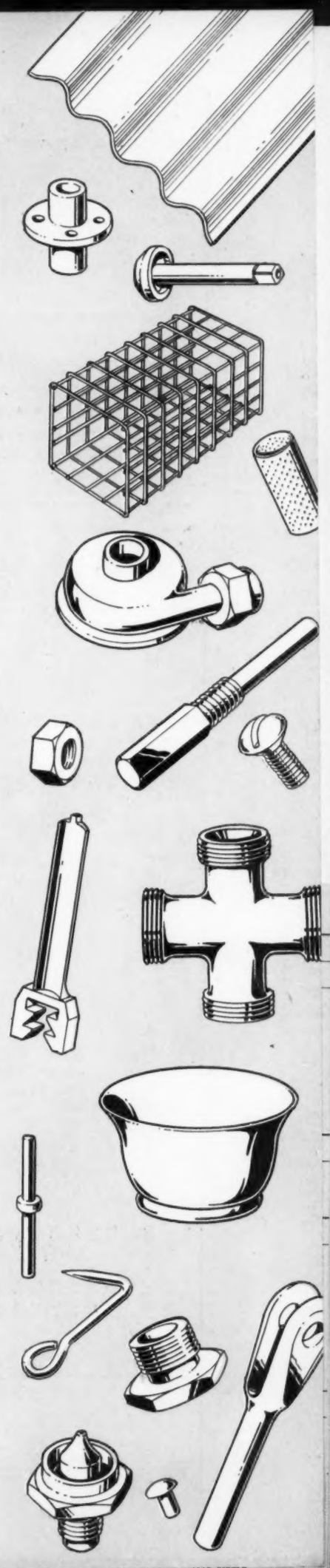


With increased load, the anode draws more electrons, causing the plasma to become more positive, thus increasing electron velocity

How to Work STAINLESS STEEL

By HAROLD L. FLYNN
Associate Editor

For centuries, men watched their handiwork in iron and steel yield to rust and gradually crumble away. As long ago as 1821, Berthier described the acid-resisting properties of iron-chromium alloys, but only in the past 25 years have we developed the versatile stainless steels which have found so many essential uses. Here are summarized best current methods for fabrication, as developed by makers and prominent users



FIRST MADE in America during World War I, stainless steel was one of the most important metals of World War II. Or, rather, one of the most important groups of metals, for a variety of alloys are grouped under this general heading. Basic requirements are iron and chromium, but a number of other elements may be added to obtain special characteristics. Two-thirds of the tonnage of stainless steels is iron-chromium-nickel alloys of the 18-8 type.

Stainless steels are usually divided into three groups, hardenable chromium, non-hardenable chromium, and austenitic chrome-nickel. Chromium is essential for true corrosion resistance; it has greater affinity for oxygen than iron, so forms a strong, highly inert film which adheres to the surface, does not thicken, does not peel and reforms at once when removed. As chromium content is increased, film tightness and stability are also increased. Moderate chromium content permits air-hardening of the alloy, so such alloys are called "hardenable."

Higher chromium contents prevent hardenability in low-carbon ranges, and high carbon impairs corrosion resistance. These high-chromium types are called stainless irons or non-hardenable chromium stainless steels. When properly annealed, they are relatively strong and ductile. Nickel protects iron against corrosive reducing agents; when more than 6 to 7% of nickel is added to a high-chromium iron alloy, an austenitic crystal pattern is set up (which has given this group of stainless steels the name of austenitic chrome-nickel) and high-temperature strength is increased. Annealed they are relatively soft and ductile, and all harden when cold-worked.

Silicon and aluminum added to stainless increase resistance to high-temperature oxidation; manganese improves hot-working; sulphur, selenium and phosphorus impart free-machining characteristics; molybdenum increases general corrosion resistance, while titanium and columbium decrease intergranular corrosion.

During the late war, more than 5,000 American fabricators worked with stainless steels, evolving many new or changed techniques. Our effort on succeeding pages has been to summarize these developments in readily usable form, to produce a concise, up-to-date handbook of preferred fabricating practice. More than 30 producers, processors and equipment manufacturers have given freely of their time and data to assist us, so the present report contains more than twice as much information as "The Working of Stainless Steels" we published in 1938.

THE PHYSICAL CHARACTERISTICS OF COMMON STAINLESS STEELS

A.I.S.I. NUMBER	Cr	Ni	C	OTHER	TEST CONDITION	TENSILE STRENGTH, M lb.	YIELD POINT, M lb.	ELONGATION IN 2 IN., %	AREA REDUC., %	BRINELL HARDNESS	AVAILABLE FORMS* B	C	CR	D	HR	P	R	S	T	FABRICATION** W	b	dd	f	r	w	MACHINABILITY***
301	16-18	7-9	.09-.20	Mn, 1.25	A	90	45	55		145-170	x	x	x	x	x	x	–	x	–	x	x	x	x	x	x	B
302	17.5-20	8-10	.08-.20	Mn, 1.25	A	90	45	60	60	130-160	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	B
302B	17.5-20	8-10	.08	Mn, 1.25 Si or Z-3 Se.07	A	100	50	60	65	150-180	x	x	x	x	x	x	–	x	–	x	x	x	x	x	x	B
303	17.5-20	8-10	.02	Mo, .60 S.07	A	90	45	60	65	130-150	x	x	x	x	x	x	–	x	–	x	x	–	–	–	x	B
304	18-20	8-10	.08	Mn, 2.0	A	95	45	60	60	135-185	x	x	x	x	x	x	x	x	–	x	–	x	x	x	x	A
308	19-22	10-12	.08	Mn, 2.0	A	90	40	65	65	135-185	x	x	x	x	x	x	x	x	x	x	–	x	x	x	x	C
309	22-26	12-14	.20		A	95	45	45	60	175-180	x	x	x	x	x	x	x	x	–	x	x	x	x	x	x	B
309S	22-26	12-14	.08		A	85	35	40		155	x	x	x	x	x	x	–	x	–	x	x	x	x	x	x	B
310	24-26	19-21	.25		A	110	60	55	55	145-205	x	x	x	x	x	x	x	x	x	x	–	x	x	x	x	B
311	19-21	24-26	.25		A	110	50	40	40	175-180	x	x	x	x	x	x	–	x	–	x	–	x	x	x	x	A
312	27-31	8-10	.25								x	x	–	x	–	x	–	x	–	x	–	–	–	–	–	—
315	17-19	7-9.5	.15	Cu, 1.5, Mo, 1-1.5	R	101	55	40	60	195-200	x	x	–	x	x	x	x	x	–	–	x	–	–	–	x	B
316	16-18	10-14	.10	Mo, 2-3	A	85	40	55	70	135-185	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	B
317	18-20	10-14	.10	Mo, 3-4	A	85	40	50		150-200	x	x	x	–	x	x	x	x	x	x	x	x	x	x	x	B
321	17-20	7-10	.10	Ti, .40+	A	90	45	55	60	135-185	x	x	x	x	x	x	x	x	x	x	–	x	x	x	x	B
325	7-10	19-23	.25	Cu, 1-1.5	A	95	55	40	50	160-190	x	x	x	x	x	x	–	x	–	x	–	–	–	x	x	C
327	25-30	3-5	.25								x	x	x	x	x	x	–	x	–	x	–	–	–	–	–	—
329	25-30	3-5	.10	Mo, 1-1.5	A	100	75	20		250-270	x	x	x	x	x	x	–	x	–	x	x	x	x	x	x	A
330	14-16	33-36	.25		R	110	50	40	50	190-220	x	x	–	x	x	x	–	x	–	x	x	–	x	x	–	B
347	17-20	8-12	.10	Cb, 1.0+	A	85	40	55	60	140-180	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	B
403	11.5-13		.15		A	85	45	35	60	135-165	x	x	x	x	x	x	x	x	x	x	–	x	x	x	x	B
405	11.5-13.5		.08	Al, 12-20	A	75	50	30	65	140-150	x	x	x	x	x	x	–	x	–	x	–	x	x	x	–	B
406	12-14		.15	Al, 4-4.5	A	75	50	30	65	140-150	x	x	x	x	x	x	–	x	–	x	–	x	x	x	–	B
410	10-14		.15		A	65	35	30	65	135-160	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	B
414	10-14	2	.15		Q	128	113	20	50	250-270	x	x	–	x	x	x	–	x	–	x	x	x	x	–	x	C
416	12-14		.15	S or Sc .07 or Mo, .60	A	85	60	35	65	145-185	x	x	x	x	x	x	x	x	x	x	(FORGE)				x	A
418	12-14		.15	W, 2.5-3.5	A	87	64	30	60	145-185		x														C
420	12-14		.15+		A	105	55	24	55	200-210	x	x	x	x	x	x	x	x	–	x	x	x	x	x	x	B
					T	225	185	7	20	420-450	x	x	x	x	x	x	x	x	–	x	–	–	–	–	–	B
420F	12-14		.15+	S or Se, .07 or Mo, .60	Q	135	75	6	7	270-280	x	x	x	x	x	x	x	x	–	x	x	–	–	x	x	A
430	14-18		.12		A	75	45	28	50	140-150	x	x	x	–	x	x	x	x	x	x	x	x	x	x	x	B
430F	14-18		.12	S or Se, .07 or Mo, .60	A	90	55	30	50	145-185	x	x	x	x	x	–	x	–	–	x	x	–	–	x	x	A
431	14-18	2	.15		Q	195	165	15	55	410-420	x	x	x	x	x	–	x	x	–	x	x	–	–	x	x	—
440	14-18		.12+		A	100	60	25	40	190-200	x	x	x	x	x	–	x	x	–	x	x	–	–	x	x	B
					T	250	190	5	5	490-495	x	x	x	x	x	–	x	x	–	x	x	–	–	x	x	C
441	14-18	2	.15+		A	235	190	5	15	425-430	x	x	x	x	x	x	x	x	–	x	x	–	–	–	x	C
442	18-23		.35		A	80	55	35	55	170-180	x	x	x	x	x	x	x	x	–	–	x	x	x	x	x	B
446	23-30		.35		A	80	50	25	45	170-185	x	x	x	x	x	x	x	x	x	x	x	x	–	x	x	x	B
501	4-6		.10+		Tube	60	25	30		160-175	x	x	x	x	x	x	x	x	x	x	–	x	x	x	x	B
502	4-6		.10		Tube	60	25	30		160-175	x	x	x	x	x	x	x	x	x	x	–	x	x	x	x	B

*Available forms—Bar stock = B; Casting = C; Cold Rolled = CR; Drawn = D; Hot-Rolled = HR; Plate Stock = P; Rod = R; Sheet = S; Tube = T; Wire = W

**Fabrication—Brazing = b; Deep Drawing = dd; Flanging = f; Riveting = r; Welding = w

***Machinability — Good = A; Fair = B; Poor = C

MACHINING

APPLICATION of stainless steels is based primarily on service characteristics such as high tensile strength and resistance to corrosion and heat. These high physicals indicate a need for heavy equipment, and suggest that machining of stainless is different—but not difficult.

All stainless steels are tough, but chrome-nickel types such as austenitic 18-8 harden considerably on cold-working. General practice to remedy or minimize this condition is to slow down, take a heavy cut and *keep on cutting.* Allowing the tool to idle in the cut glazes and hardens the work and makes resumption of cutting extremely difficult and dangerous. It is significant that those fabricators who report the least trouble in machining stainless make a practice of using oversize motors on all equipment. They can take a heavy cut without fear of chatter and resultant hard spots.

Availability of free-machining stainless steels in both straight-chromium and chromium-nickel groups simplifies many jobs. Inclusions of sulphur or selenium and phosphorus in varying amounts offer a valuable chip-breaking medium, allowing speed to be increased about 25%. These types are specified where considerable machining is involved and where service requirements warrant. Inclusion of these free-machining elements is accompanied by a slight decrease in corrosion resistance ductility and welding characteristics. Sulphur-bearing stainless is sometimes preferable where heavy cuts are to be taken and selenium is suitable on lighter cuts.

Proper tool-type selection may be a deciding factor in successful machining on many jobs. Highspeed-steel tools, tungsten, molybdenum, cobalt, or vanadium alloys meet most machining requirements. High-cobalt or cast alloys are preferred types and allow an increased speed. Cemented carbides are recommended on many continuous-cutting applications requiring high finish and considerably increased speeds. Compromise must be made between high cutting speeds and toughness, to meet such requirements as tapping and threading, where tool toughness is essential. Type of equipment, special tool grinds and individual preferences of setup men will determine final tool-type selection.

Careful grinding of tools and maintenance of sharp cutting edges is of major importance in machining stainless. Stoning of tools after grinding is so important that it is strongly recommended for all stainless work. Tool life is extended and maintenance of uniform cutting rates minimizes cold-working tendencies.

TURNING TOOLS. A slight nose radius and a top rake angle of 5 to 10° are suggested for single-point turning tools, the larger rake being preferable for chromium-nickel types of stainless. Lip rake of 15 to 20°, side rake of 5 to 10° and a clearance of 2 to 5° give a free-cutting action. Life of cemented-carbide tools can be extended by breaking the sharp cutting edge with a hand hone. A finishing cut should remove less than 0.020 in. at feeds of 0.001 to 0.005 in. per revolution. If the piece heats up when turning chromium-nickel types, slacking back on the centers may be necessary.

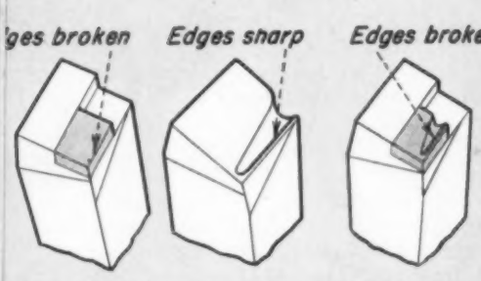
For medium or light cuts, a chip-breaker is recommended to eliminate long stringy chips, particularly for cemented-carbide tools. A chip-curler grind, where the groove does not break through the front edge of the tool, permits greater depth of cut.

FORM TOOLS. Forming of the chromium-nickel types of stainless, exclusive of the free-machining types, must be carried out at relatively slow speeds. On deep cuts, compensation for side clearance of 2 to 5° should be made to prevent galling and to balance end-thrust. A shave tool, set up on another station, can remove

TURNING SPEEDS AND FEEDS

AISI NUMBERS →	302	303	309	347-321	403-416	416	430-F	
AUTOMATIC SCREW MACHINE				SPEEDS S.F.P.M.				FEEDS-IN
Box Tool —Rough	70-90	100-130	60-80	70-90	90-100	120-150	130-160	0.002-0.005
Finish	70-90	100-130	60-80	70-90	90-100	120-150	130-160	0.002-0.005
Form Tool—Rough	70-90	100-130	60-80	70-90	90-100	120-150	130-160	0.0005-0.0009
Finish	70-90	100-130	60-80	70-90	90-100	120-150	130-160	0.0002-0.0004
Drills (⅛" ⅝"(	70-90	100-130	60-80	70-90	90-100	120-150	130-160	0.002-0.006
Reaming	70-90	100-130	60-80	70-90	90-100	120-150	130-160	0.003-0.0075
Turning	70-90	100-130	60-80	70-90	90-100	120-150	130-160	0.005-0.0015
Cutoff	70-90	100-130	60-80	70-90	90-100	120-150	130-160	0.0005-0.001
AUTOMATIC SCREW MACHINE SWISS TYPE								
Turning	80-120	110-130	80-120	80-120	110-140	120-150	130-160	0.0005-0.0009
Cutoff	80-120	110-130	80-120	80-120	110-140	120-150	130-160	0.0002-0.0003
Dr ll ng	80-120	110-130	80-120	80-120	110-140	120-150	130-160	0.0005-0.0010
TURRET LATHE (H.D.)								
Box Tool —Rough	60-80	90-120	60-80	65-85	80-100	100-130	110-130	0.005-0.015
Finish	60-80	90-120	60-80	65-85	80-100	100-130	110-130	0.005-0.010
Form Tool—Rough	60-80	90-120	60-80	65-85	80-100	100-130	110-130	0.001-0.002
Finish	60-80	90-120	60-80	65-85	80-100	100-130	110-130	0.0005-0.001
Drilling	60-80	90-120	60-80	65-85	80-100	100-130	100-130	0.003-0.005
Reaming Rough	60-80	90-120	60-80	65-85	80-100	100-130	110-130	0.005-0.0015
Finish	60-80	90-120	60-80	65-85	80-100	100-130	110-130	0.003-0.0075
Cutoff ...—Hand Feed	60-80	90-120	60-80	65-85	80-100	100-130	110-130	0.0005
Power Feed	60-80	90-120	60-80	65-85		100-130	110-130	0.0025
MULTIPLE SPINDLE (H.D.)								
Box Tool —Rough	75-95	100-130	75-95	80-95	85-105	110-130	125-165	0.005-0.010
Finish	75-95	100-130	75-95	80-95	85-105	110-130	125-165	0.003-0.005
Form Tool—Rough	75-95	100-130	75-95	80-95	85-105	110-130	125-165	0.001-0.003
Finish	75-95	100-130	75-95	80-95	85-105	110-130	125-165	0.0005-0.001
Turning —Rough	75-95	100-130	75-95	80-95	85-105	110-130	125-165	0.005-0.010
Finish	75-95	100-130	75-95	80-95	85-105	110-130	125-165	0.003-0.005
Drilling	75-95	100-130	75-95	80-95	85-105	110-130	125-165	0.005-0.010
Cutoff	75-95	100-130	75-95	80-95	85-105	110-130	125-165	0.001-0.003
Shaving	75-95	100-130	75-95	80-95	85-105	110-130	125-165	0.003-0.005
Reaming	75-95	100-130	75-95	80-95	85-105	110-130	125-165	0.003-0.0075

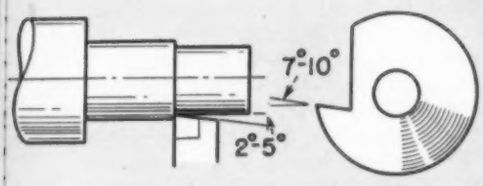
TURNING TOOLS



Chip-breaker grind for box tool

Chip-curler groove for high-speed steel tool

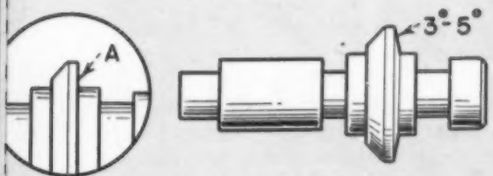
Chip-curler groove for carbide tool



Recommended clearance angle for stainless steel

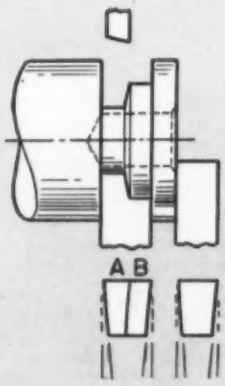
Recommended top rake angle

FORM-TOOL GRIND



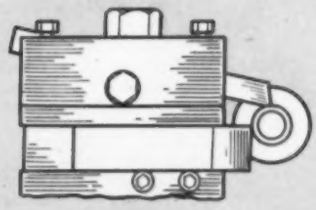
Conventional form tool will pick up on stainless and wear at A

Modified circular form test with 3°-5° angle will yield longer tool life



Loss of size at dimension (A) after grinding can be compensated by moving the cut-off blade. Size at B will remain constant

SHAVING



Conventional shave and cut-off tool imparts fine finish to stainless

excess metal. For this reason, a circular form tool should be used in preference to a dovetail tool.

Relatively wide form tools that are rigidly supported to prevent vibration cause chatter and loss of accuracy. Rigid supports or wedges placed under the tool overhang, reduce chatter and enable increased feeds to be used. Making the tool up in two parts, mounted separately, helps prevent chatter. Carbide-insert bushing supports for the free end of the work have been successfully used. Form tools should be located as close to the work as possible.

Top rake angles should be incorporated into the design of the tool and maintained carefully. Roughing form tools with a slight chamfer to remove sharp corners reduces tool failure and allows higher cutting rates.

Particular attention should be paid in rough-grinding form tools to avoid burning or cracks which cannot reasonably be removed in finish-grinding. A hand hone, kerosene dipped, gives a good finish and prevents loading. Excessive angles resulting from grinding on the face of a wheel should be avoided as they weaken the cutting edge and may impair the finish.

High-speed tools give good results, where heavy feeds are used and when equipment is operating near its top bar-size capacity. Carbide or cast-alloy form tools, provided with cushions to resist cutting impact, withstand abrasion and provide a good finishing medium. Top rake angles from 7 to 10° are suggested.

DRILLING. High-speed steel drills, preferably with spiral helix, are effective on stainless. Tools should be sharp, slightly flatter than standard, rigid and as short as possible to avoid springing. The web should be thinned to reduce drilling temperatures. Step-drilling and use of crankshaft drills with 140° point angles is suggested for deep holes.

The drill should not dwell without cutting, particularly with the work-hardening chromium-nickel grades. Drill-jig bushings should be short to accommodate the recommended short drills, and should be removable if chip congestion is a problem.

Speeds and feeds, particularly with small drills, should be controlled carefully. If the drill diameter approaches or exceeds three-quarters of stock thickness, speeds should be reduced. If the drill is less than one-quarter stock thickness in diameter, speeds should be increased. A "cotter-pin" drill works well on small holes, with proper speed and low feed.

DRILLING SPEEDS & FEEDS

Drill, in.	Speed, rpm.	Feed, in.	Drill, in.	Speed, rpm.	Feed, in.
1/4	688	0.002	1 1/4	137	0.008
5/16	550	0.002	1 5/16	131	0.009
3/8	458	0.003	1 3/8	125	0.010
7/16	393	0.003	1 7/16	119	0.010
1/2	344	0.004	1 1/2	115	0.011
9/16	306	0.004	1 9/16	110	0.011
5/8	276	0.004	1 5/8	106	0.011
11/16	249	0.005	1 11/16	102	0.012
3/4	229	0.005	1 3/4	98	0.012
13/16	213	0.005	1 13/16	95	0.013
7/8	196	0.006	1 7/8	92	0.013
15/16	183	0.006	2	86	0.013
1	172	0.007	2 1/8	81	0.014
1 1/16	162	0.007	2 1/4	76	0.014
1 1/8	153	0.007	2 3/8	73	0.015
1 3/16	145	0.008	2 1/2	69	0.015

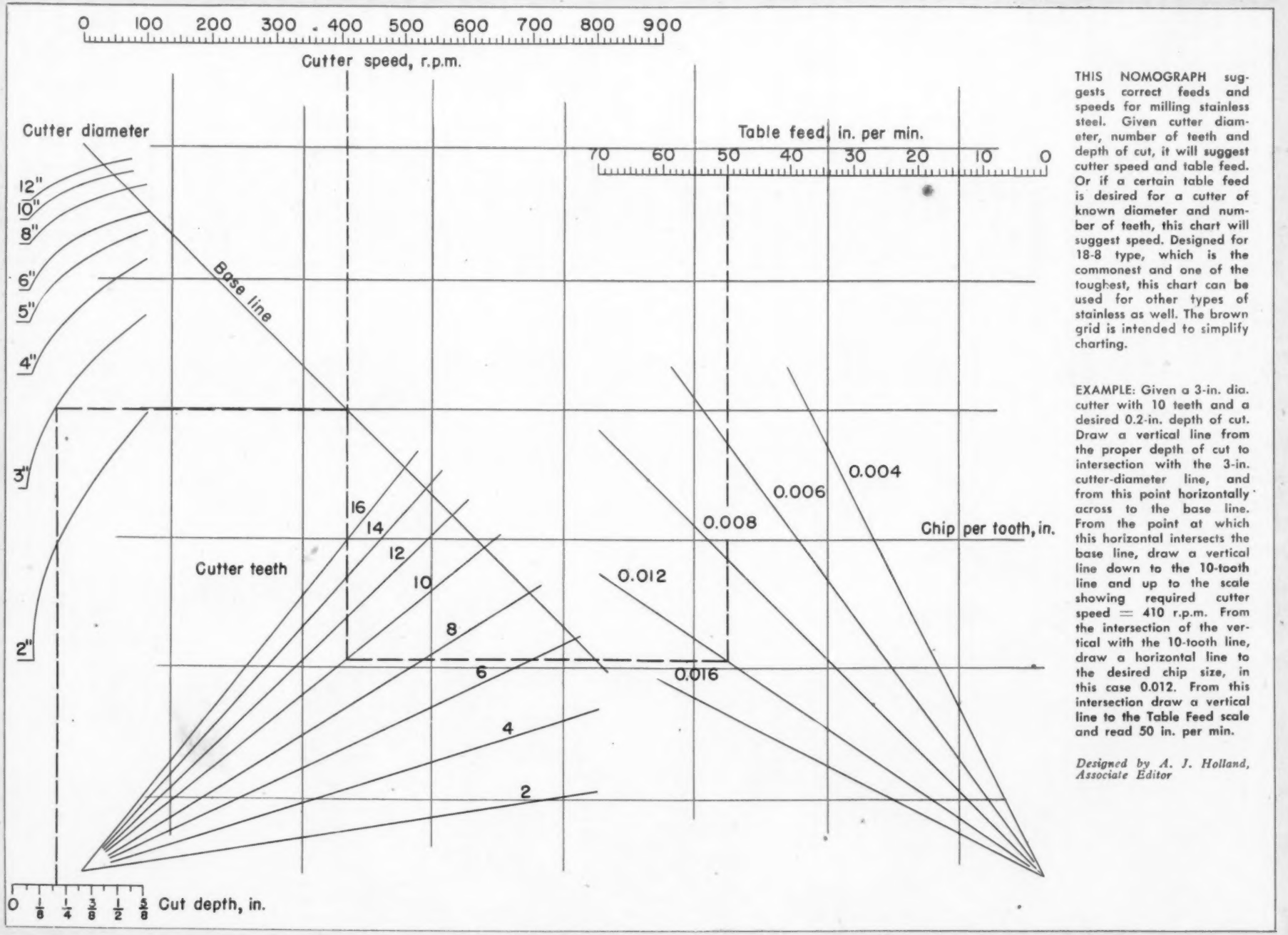
For shallow holes, conventional points should be changed to 130 to 135° included angle.

A 12° web back of the point and 12 to 16° lip clearance angles is effective practice on stainless. Lip clearance of 8 to 12° may be used on small drills. Cutting edges may be flattened and both heels ground off at a 45° angle on larger drills.

REAMING. Spiral-fluted reamers with narrow lands and a secondary lead angle, mounted on a floating holder, are suggested for stainless. For tapered sections, where a fine finish is required, a taper-turning attachment is preferable to a tapered reamer. Carbide-tipped reamers improve finish and should be used where high production is required. Feeds should increase in proportion to size of hole being reamed. Feeds of from 0.003 to 0.006 in. for reamers up to ½ in. and 0.006 to 0.012 in. for reamers up to 1 in. are suggested.

TAPPING. Ground-thread taps for class 2 fit, with slightly more taper than those used on dead-soft brass, and having a hook grind of about 15° are indicated for stainless. A slight negative rake and decreased tooth height and thickness at the center portion facilitate tapping. Interrupted-thread taps with thinned-out lands are used for deep holes, and 2-fluted laps with 15 to 20° shear angle for through holes. Collapsible taps with a 15 to 20° lip hook are excellent for holes over 1 in.

When a tap is shortened for bottom tapping, the taper lead should be maintained. Threads in chromium-nickel tend to swell and may be compensated for by using a slightly larger drill than for plain carbon steel. Two-fluted taps provide maximum strength



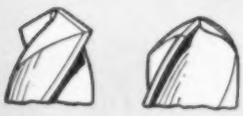
THIS NOMOGRAPH suggests correct feeds and speeds for milling stainless steel. Given cutter diameter, number of teeth and depth of cut, it will suggest cutter speed and table feed. Or if a certain table feed is desired for a cutter of known diameter and number of teeth, this chart will suggest speed. Designed for 18-8 type, which is the commonest and one of the toughest, this chart can be used for other types of stainless as well. The brown grid is intended to simplify charting.

EXAMPLE: Given a 3-in. dia. cutter with 10 teeth and a desired 0.2-in. depth of cut. Draw a vertical line from the proper depth of cut to intersection with the 3-in. cutter-diameter line, and from this point horizontally across to the base line. From the point at which this horizontal intersects the base line, draw a vertical line down to the 10-tooth line and up to the scale showing required cutter speed = 410 r.p.m. From the intersection of the vertical with the 10-tooth line, draw a horizontal line to the desired chip size, in this case 0.012. From this intersection draw a vertical line to the Table Feed scale and read 50 in. per min.

Designed by A. J. Holland, Associate Editor

DRILLING

Land .010" to .062" wide at 7° strengthens cutting edge



Groove to assist chip elimination on automatics or where clogged chips cause overheated drills

r shallow holes
0° points should
used

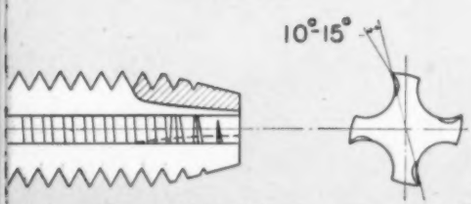
118° Standard
130° Stainless

REAMING

° 3° lead angle to this point

Recommended grind for reaming stainless

TAPPING



Hook grind should include first full tooth

and chip-clearing characteristics. Nitriding of National Fine taps has resulted in longer tool life and less tendency to chip welding.

THREADING. Self-opening dieheads with a 3- to 4-thread lead provide economical operation on heavier stock, while acorn dies are suitable for lighter work. Hobbed chasers give a good thread on free-machining stainless steels, while milled chasers are recommended for regular stainless grades. Collapsible threading dies with tangent-type chasers are suggested for external threading.

Threading speed for chromium-nickel stainless is about half that for plain carbon steels. Lip rake angles of 20 to 25° for chromium-nickel and 5 to 10° for straight-chrome grades minimize galling and seizing. For finishing, speeds of 5 to 10 s.f.p.m. are maintained, removing 0.005 to 0.010 in.

MILLING. A slight top rake angle on milling cutters is of advantage. Because of the high cutting pressures developed in milling stainless, jigs and fixtures should be heavy and rigidly mounted to insure enough damping effect. When table feeds are calculated, chip loads are from 0.005 in. up per tooth, depending upon horsepower available. Spindle speeds are determined by depth of cut and power of machine and are generally lower than for carbon steel. An accompanying nomograph gives complete milling data on stainless steel of the free-machining 18-8 type.

SKIVING. A skive tool, either flat or dovetail, produces accurate sizes on stainless. A shear angle of about 10 to 15° helps reduce cutting pressure. The cutting edge is ground with a clearance angle of 1 to 2° and a front rake angle of 10 to 15°. These tools operate at the same speed as form tools, and may be used in single-spindle automatics, turret lathes and to replace wide finish-form tools on bench lathes.

SHAVING. Shave tools are suitable for fine finish requirements on multiple-spindle equipment, and the entire length of the cutting edge is in contact with the work during the cutting action. Cutting pressures are high, but the stroke is short. Shave tools are usually carbide or cast-alloy tipped and employ the same feeds as form tools.

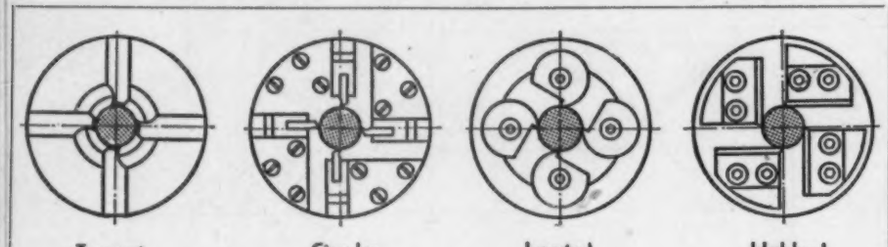
Good box-tool practice is to set the roller about 0.010 in. behind the tool and provide a 0.010-in. land at the cutting edge. No land should be provided on the edge forming the side relief angle.

BORING. Internal boring bars should be made as short and rigid as possible, using the largest diameter which will maintain chip elimination. Long slender bars should have a pilot and bushing mounted in the lathe headstock. Carbide or cast-alloy tools are suggested for finishing cuts. High-speed steel tools are suggested for rough-boring. Cuts should be continuous, particularly on chromium-nickel types.

COOLANTS. Mineral oil is used for lubrication of cutting tools on automatics. Water-soluble oils have permitted increased cutting rates on equipment with carbide tooling. Sulphur-chlorinated oils of the extreme pressure type have good anti-weld properties where heavy cuts and slow speeds are employed. When speeds are increased and feeds decreased, the oils may be diluted with paraffin oil. If smoking occurs, the mixture should be diluted with mineral oil of the proper viscosity.

Stainless steels containing from 0.35 to 1.10 carbon have a high abrasive action, so cemented-carbide or cast cobalt tools, along with a heavily compounded cutting oil containing active sulphur, are suggested. As 23 to 27% straight-chromium steels become gummy in machining, cutting speed should be lowered, top rake increased, and an oil high in cooling action and low in lubricity should be used, increasing friction quality of the chip.

STANDARD CHASER GRINDS FOR STAINLESS



Tangent | Circular | Inserted | Hobbed

TYPE OF HEAD	Grades 403 410 431 430 446	Grades 420 420F 440A 440C 440F	Grades 302 304 309 316 347	Grades 416* 430F 303
Tangent	20°-28°	15°-20°	20°-28°	10°-20°
Circular	20°-25°	15°-20°	20°-30°	20°-25°
Inserted or Milled	10°-12°	10°-12°	10°-12°	7°-10°
Hobbed or Tapped or Solid	10°-15°	7°-10°	10°-15° or Hook	7°-10°

*Free machining grades.

HEAT-TREATMENT

Heat-treating of stainless steels requires no unconventional equipment or methods, but does require close attention to certain heat-treating variables. Annealing and heat-treating of stainless should:

1. Restore maximum corrosion resistance of the chromium-nickel alloys after fabricating procedures involving heating and slow cooling through the carbide-precipitation range.

2. Relieve stresses residual in the material after fabrication.

3. Obtain the physical properties required in those structural alloys which respond readily to heat-treat-

Electric, gas-fired, oil-fired, salt-bath or induction furnaces (designed for high-temperature work) may be used for heat-treating stainless steels. Hydrocarbon controlled atmospheres should be avoided.. Maintenance of uniform temperature and protection against direct flame from burners is necessary. Salt baths, either internally or externally heated, and using chemically neutral salts which introduce no carbon or nitrogen into the work surface, provide a minimum amount of scale on stainless steels. Common salts used are chlorides of barium, sodium, calcium and potassium for high temperatures and sodium and potassium nitrates for lower temperatures. Any type of cyanide should be avoided as it will carburize or nitride the surface of stainless.

Hardening and annealing of stainless steels by flame-heating procedures produces negligible scale and distortion. By proper adjustments of conditions, a hard surface and moderately soft and ductile core can be secured. Areas locally heated may be air-cooled or oil-quenched. Induction heating is being successfully applied by techniques similar to those for carbon steel.

Where completely scale-free heat-treatment is required, especially prepared atmospheres of dry cracked ammonia or dry hydrogen are used. Oxidizing atmospheres generally produce a thick scale which is more easily removed by pickling. Parts, particularly of the chromium-nickel type, if contaminated with grease, oil or organic materials, will be carburized locally.

HARDENING. A wide range of "as quenched" hardness is available in the straight-chromium types, depending primarily on carbon contents. In

TABLE I—HARDENING RANGES—STRAIGHT CHROMIUM

Type	Preheating Temperature, F.	Time at Preheat, hr.	Hardening Temperature, F.	Hardness	
				Brinell	Rockwell
410, 403, 416	*	*	1700-1850	380-415	C 39-43
414	*	*	1800-1950	400-450	C 42-47
431	*	*	1800-1950	440-440	C 42-46
420	1000-1450†	1 to 1¼	1800-1900	530-560	C 53-56
440A	1000-1450	1 to 1½	1850-1950	555-590	C 55-58
440B	1000-1450	1 to 1½	1850-1950	575-610	C 57-59
440C	1000-1450	1 to 2	1850-1950	620-630	C 60-62

*—Not necessary except where large forgings involved. †—Small sections may be brought quickly to pre-heat (1450 F).

TABLE II—STRESS-RELIEVING PROCEDURE

Type	Temperature, °F.	Time, hr.	Hardness	
			Brinell	Rockwell
410, 403, 416	450-700*	1 to 3	360-800	C37-40
414	450-700	1 to 3	380-420	C40-44
431	450-700	1 to 3	355-400	C36-42
420	300-700	1 to 2	470-530	C48-53
440A	300-700	1 to 2	500-560	C51-56
440B	300-700	1 to 2	520-580	C53-58
440C	300-700	1 to 2	540-620	C55-60

*—Low side of range for maximum hardness; middle for max. toughness; high side for max. elasticity.

TABLE III—ANNEALING HARDENABLE GRADES

PROCESS-ANNEALING PROCEDURE

Type	Temperature, F.	Time, hr.	Cooling	Hardness	
				Brinell	Rockwell
410, 403, 416	1350-1450	1-3	Any	170-195	B86-92
414	1200-1300	4-8	Any	240-255	B99-C24
431	1150-1225	4-8	Any	230-260	B97-C24
420	1350-1450	2-6	Any	205-225	B86-92
440A	1350-1450	2-6	Any	230-245	B97-C22
440B	1350-1450	2-6	Any	235-250	B98-C23
440C	1350-1450	2-6	Any	240-255	C22-C27

FULL-ANNEALING PROCEDURE

410, 403, 416	1550-1650	1-3	Slow cool	135-160	B75-83
420	1600-1650	1-2	Slow cool	155-180	B81-89
440A	1625-1675	1-2	Slow cool	190-215	B91-95
440B	1625-1675	1-2	Slow cool	205-230	B94-98
440C	1625-1675	1-2	Slow cool	215-240	B95-99

ANNEALING NON-HARDENABLE GRADES

430	1450-1550	1-2	Air or water	140-165	B77-85
430F	1250-1450	1-2	Air or water	165-190	B85-91
442	1450-1550	1-2	Air or water	150-175	B80-88
446	1450-1550	1-2	Air or water	160-185	B84-90

TABLE IV—ANNEALING CHROMIUM-NICKEL GRADES

Type	Temperature, F.	Time, min.	Quench	Hardness	
				Brinell	Rockwell
301	1850-2050	10-30	Water	155-175	B80-90
302	1850-2050	10-30	Water	140-160	B75-84
304	1850-2050	10-30	Water	140-160	B75-84
303	1800-2050	10-30	Water	155-175	B80-90
308	1850-2050	15-30	Any	145-165	B75-85
309	1850-2050	10-30	Any	165-185	B85-95
310	1900-1950	15-30	Water	165-185	B85-95
316	1950-2050	10-30	Air	140-160	B75-85
321	1700-1950	10-30	Water	145-160	B75-85
347	1700-2000	10-30	Water	145-165	B75-85

the case of the high-carbon grades, small variations in carbon and chromium content do not have any marked effect on the maximum quenched hardness.

Preheating is not usually required except for large or complicated sections or where materials, such as forgings, are being charged in the hardened condition. Bringing to heat rapidly under these conditions may cause thermal stresses and cracking. However, preheating the high-carbon types of hardenable stainless is recommended, starting at 1000 F. and raising slowly to approximately 1450 F. Holding at preheat temperature for 1 to 2 hr. soaks the parts sufficiently to permit them to be raised rapidly to hardening temperature.

Maximum hardness of straight chromium is not secured until the hardening temperature is raised several hundred degrees above the lower critical temperature. Parts quenched from intermediate temperatures of 1475-1950 F. will develop hardnesses ranging from that of annealed material up to that of fully hardened material, depending on the quench temperature and type. Hardening in this range results in a microstructure less tough than when fully hardened.

The high side of the hardening range will produce the maximum hardness and toughness after quenching and stress-relieving. Where the material is tempered after hardening, however, choice of the low side of the hardening range is suggested for maximum impact strength.

Once the load or part is at temperature, long soaking is not necessary or desirable. Ten to fifteen minutes for small parts and half an hour for large sections is adequate holding time. Increasing the soaking time beyond this point does not increase hardness and may cause decarburization and grain growth.

Hardenable stainless steels will harden uniformly throughout on oil-quenching or air-cooling, the former producing higher hardness and elastic limit and the latter being useful for handling irregular and sharp-filleted sections not suitable for rapid quenching or where distortion or cracking of hardened parts is possible. Water-quenching is likely to produce quench cracks, particularly in the high-carbon grades. Parts which are later stress-relieved or tempered should not be removed from the quenching tank and transferred to the stress-relieving furnace until they have cooled below 550-750 F. and have become definitely magnetic.

Hardening treatments should be followed by a low-temperature draw to relieve stresses. In the high-carbon grades this should be done immediately after quenching, while the parts are still warm. Stress-relieving may be followed by air-cooling or quenching in oil or water.

TEMPERING. Tempering of hardened 403, 410, and 416 types takes place between 1000-1400 F. As temperature is increased or holding time prolonged, tensile strength, yield strength and hardness decrease, while impact strength, elongation and reduction in area increase. Close control of temperature, especially at lower temperatures, is desirable and time is from 1 to 4 hr., the longer periods being employed for lower temperature. Parts are usually air-cooled but may be oil- or water-quenched to facilitate handling.

ANNEALING — HARDENABLE GRADES. Full softening of hardenable grades is obtained by heating above the critical temperature, followed by slow cooling. Cooling rate may be varied between 25 and 50 F. per hr., the slower rates giving slightly lower hardness. Slow cooling is usually stopped at 1100-1200 F., the material withdrawn from the furnace and cooled as rapidly as possible.

For some processing operations such as cold heading (17-Cr., high-carbon, 440) a useful softening treatment is heating to 1625-75 F. for 2 to 3 hr., furnace cooling to 1400-50 F., holding 4 to 6 hr., slow furnace cooling of 25 to 50 F. to 1000-1100 F., followed by air-cooling. Type 431 does not respond to slow-cool annealing, and a process anneal at 1150-1225 F. for 4 to 8 hr., followed by air-cooling or quenching is suggested.

Unless maximum softness or ductility of hardenable grades is required for severe cold-forming operations, full-annealing is not necessary. A process anneal just under the critical temperature is sufficient.

ANNEALING — NON-HARDENABLE GRADES. Straight-chromium alloys of the 430, 442, 446 group cannot be hardened to any appreciable extent by quenching from high temperature. These alloys tend to develop a coarse-grained structure if held for any prolonged period above 1650 F. and may become embrittled by such treatment. If maximum temperatures are observed, these alloys may be rapidly cooled for improved impact properties. Where type 430 is to be subjected to severe cold-forming operations, an annealing cycle of heating to 1500-1650 F. for 2 to 3 hr., slow cool to 1000-1200 F. at a rate of 25-50 F. an hour, then air-cool to room temperature can be followed.

ANNEALING — CHROMIUM-NICKEL GRADES. Alloys in this group are austenitic, non-magnetic and generally cannot be hardened by thermal treatment. Annealing is to:

1. Obtain maximum ductility by removal of cold-working stresses.

2. To dissolve any chromium carbides which may have been precipitated during forging or welding or slowly cooling through the critical range of 800-1600 F.

Such carbides, when present in grain boundaries, must be redissolved by reheating above 1600 F. and rapid cooling to hold them in solution. In general, the low side of the range may be used when carbon content is low and the high side when carbon content is high. Higher annealing temperatures give lower hardness.

Very small parts can often be air-cooled, but larger parts should be water-quenched. The principal advantage of air-cooling is to minimize distortion in thin sections. Water-quenching of type 310 (25-20) is always recommended, as carbides will be precipitated even on rapid air-cooling. Large parts or heavy loads must be quenched quickly so they don't cool below 1600 F. before immersion.

Types 321 and 347 have titanium and columbium added to combine with the carbon and minimize formation of chromium carbides, to form stabilized alloys for ease in welding and where parts are to be exposed subsequently to severe corrosion conditions. More complete stabilization is secured at lower annealing temperatures. Where maximum ductility is required for later cold-deforming, the upper range may be used.

A further treatment is heating the annealed or welded material to 1600-1650 F. for 1 to 3 hr. and air-cooling or water-quenching. This is sometimes used to get complete precipitation of all carbides as stable ones.

Recently, a proprietary precipitation-hardening stainless steel of the 18-8 type has been announced. By prescribed heat-treatment, this steel can be raised to a Rockwell C hardness of 39-47, tensile strength to about 225,000 psi., and yield strength to about 180,000 psi.

Typical analysis of this alloy, Stainless "W," is C, .07; Mn, .50; P, .010; Si, .50; Ni, 7.00; Cr, 17.00; Ti, .70; Al, .20; and Fe, the balance. Most important element is titanium, which is the primary precipitation-hardening agent and a strong ferrite former.

FORGING

Stainless steels are tougher at elevated temperatures than forging-quality mild steels, and require more time to reach forging temperature. Surface defects in billets and bars, such as roll marks and seams, are a more serious problem because stainless will not forge-weld. Stainless steels also require about 25% more hammer blows than forging steels and twice as much power. Temperature should also be watched carefully. The higher the carbon, the sooner working must stop for reheating, particularly with the chromium-nickel types.

Steam hammers, capable of striking heavy or light blows as desired, are suitable for forging stainless. Drop hammers are used on some types of work, and many designs may be adapted to forging by additional steps in the die for breaking down, or by including an additional semi-finishing operation. Allowance for trimming is generally 0.01 to 0.07 in.

Careful selection of steel for forging dies is advisable, as die life will be approximately half that with mild steels. Careful preheating will extend die life and improve forging.

Small sections, such as 1-in. bars and smaller, may be heated directly to forging temperature, but larger sections should be preheated and allowed to soak through about twice as long as mild steel. Excessive temperatures may cause splitting and rupturing of the steel, while low temperatures set up unequal stresses and cause subsequent cracking. Straight-chromium steels are susceptible to grain growth at high temperatures, and long soaking at forging temperature is undesirable.

The first blows of the hammer are struck lightly, and after the breakdown, forging proceeds rapidly as chromium-nickel steels work-harden even when quite hot. With higher chromium-nickel content such as 25-20 and 25-12, forging blows should become progressively lighter in finishing as temperature drops.

Stainless-steel forgings should be trimmed hot and restruck by the hammer whenever possible. A sufficiently high temperature prevents tearing or breaking. If cold trimming cannot be avoided, forgings should be annealed, then trimmed.

Stainless steels of the hardenable, straight-chromium type should be slowly cooled from the forging temperature to avoid excessive hardening. The unstabilized chromium-nickel type will show carbide precipitation if cooled slowly.

FORGING AND PREHEAT TEMPERATURES

Grade	Preheating, F.	Begin Forging, F.	Finish Forging, F.	Soaked at Heat	Rate of Cooling
302	1500-1600	2100-2200	1600-1700	Limited	Rapid
303 (1)	1500-1600	2100-2200	1600-1700	Limited	Rapid
347 (2)	1500-1600	2100-2200	1600-1700	Limited	Moderate
321 (2)	1500-1600	2100-2200	1600-1700	Yes	Moderate
316 (2)	1500-1600	2100-2200	1600-1700	Yes	Moderate
309 (2)	1500-1600	2150-2250	1700-1800	Yes	Moderate
310 (2)	1500-1600	2150-2250	1700-1800	Yes	Moderate
430 (3)	1400-1500	1900-2000	Under 1450	Limited	Rapid
446 (3)	1400-1500	1900-2000	Under 1450	Limited	Rapid
410	1400-1500	2000-2100	Under 1500	Yes	Slow
416	1400-1500	2000-2100	Under 1500	Yes	Slow
403	1400-1500	2000-2100	Under 1500	Yes	Slow

Notes:
(1) Not recommended for severe forging operations.
(2) Do not form below 1800 F. Finish below this temperature only with light blows in the final sizing.
(3) Avoid long soaking at forging temperatures to guard against decarburization and excessive grain growth.

SCALE REMOVAL

Scaling at the relatively high temperatures required for welding, annealing and forging makes scale removal a necessity. Lower-alloy grades scale or oxidize more at high temperatures than higher-alloy types, and scale is more tenacious.

SANDBLASTING AND PASSIVATING. Sandblasting removes heavy scale which would otherwise require excessive pickling. Procedure is conventional, and clean sand is used instead of metal shot. The blast is passed over the area continuously at minimum air pressure, particularly with lighter gages. If the work is to have a final polishing, scale should not be removed by sandblasting. After blasting is finished, the article should be passivated to provide an adequate protective oxide film and dissolve particles of foreign material which may be lodged in the surface. Surfaces must also be free of heavy grease and oil. To passivate, clean parts may be immersed in:

A hot solution (15-20% at 130-40 F.) of nitric acid for 10-15 min., then scrubbing in clean hot water.

Or 20-40% nitric acid at 120-40 F. for 15-30 min., followed by wash.

PICKLING. Any of the solutions given are subject to variation in concentration and temperature depending upon the condition and volume of scale. Thorough rinsing and scrubbing in hot water is essential to remove adhering acid. For chromium-nickel steels, use solution No. 3 to soften and rot scale, checking for any possible etching action, and after cleaning, solution No. 2 may be used. Color and appearance of stainless may be improved by a 10- to 15-min. dip in 10-20% (130-140 F.) commercial nitric acid (Sp. Gr. 1.42) followed by hot-water rinse.

Most steel mills are using the DuPont sodium-hydride process of scale removal. Sodium hydride is dissolved in fused caustic, reducing metallic oxides to loosely adherent form, taken from the surface by a water quench. Removal of the scale is easily effected without pitting or loss of metal.

PICKLING SOLUTIONS

1. Sulphuric acid (Sp.Gr. 1.84).....6-8 parts by vol.
   Hydrochloric acid (Sp.Gr. 1.60).....2-4 parts by vol.
   Water, to make.....100 parts by vol.
   Operating temperature.....140-160 F.
2. Nitric acid (Sp.Gr. 1.42)...10-20 parts by vol.
   Hydrofluoric acid.....1-4 parts by vol.
   Water, to make.....100 parts by vol.
   Operating temperature.....100-125 F.
3. Sulphuric acid.....10 parts by vol.
   Rock salt NaCl.....¼ lb. per gal.
   Water to make.....100 parts by vol.
   Operating temperature.....160-180 F.
4. Sodium hydroxide.....20 parts by wt.
   Potassium permanganate....5 parts by wt.
   Water, to make.....100 parts by wt.
   Use boiling hot.....230 F.

Note:
Solution 1—A first operation, loosens heavy scale.
Solution 2—Removes scale loosened by No. 1 or first operation where scale is light. Adequate ventilating devices should be used.
Solution 3—Preferred for straight chromium grades.
Solution 4—After cold-rolling. For light uniform scale.

WELDING

STAINLESS STEELS containing both chromium and nickel are more readily welded than those containing only chromium, and the weld joints are strong, ductile and tough in the as-welded condition. Steels containing chromium only are less ductile after welding and should be annealed or tempered.

If chromium-nickel steel in its fully annealed condition is held around 1200 F. for any length of time, carbon separates from solid solution and unites with chromium to form carbides. This carbide precipitation takes place anywhere in the 800-1600 F. range, the maximum effect being at 1200 F. High-carbon chromium-nickel steels are more susceptible to carbide precipitation than those of a lower carbon content. This action can be controlled by avoiding holding at temperatures within the carbide precipitation range and using steels on which carbon, chromium and nickel are in proper balance. Its chief effect is on corrosion resistance and not on tensile or yield strengths.

Stabilized alloys 321 and 347, containing titanium and columbium, prevent formation of harmful chromium carbides by making up other harmless carbides. Where chromium carbides are formed in welding other chromium-nickel alloys they may be removed by heating to 1950 F. and quickly cooling the area.

Welding of stainless steel may be termed precision welding, for the operator must think not only of mechanical strength, but also of retention of corrosion resistance. Close control of all variables is mandatory. Compared with plain carbon steel, chromium-nickel stainless behaves in the following manner:

1. Expands 50% faster.
2. Conducts heat only about 40 to 50% as fast.
3. Has an electrical resistance about 6 times that of carbon steel.
4. Has a lower melting point, requiring less current.
5. Grain-size reduction is more difficult.

ARC WELDING. Fusion welding by metallic arc provides instantaneous heat at the point needed and for just the right length of time and provides quick dissipation and minimum heat build-up.

Metallic-arc electrodes are coated with prepared flux which rises to the top of the pool and protects the deposit from oxygen and nitrogen of the air as the bead cools. Some of the ingredients of stainless-steel electrodes such as chromium and columbium, are partially lost in passing through the arc. Rod analysis must compensate for this, as additions can be made to the flux coating. About 25% of the columbium originally in the electrode analysis is lost, so compensation must be made. Nickel and molybdenum are not lost to any appreciable extent when passing through the arc. Control of carbon is obtained by using low-carbon rods.

Direct current is more frequently used than alternating current for metallic-arc welding of stainless, and reverse polarity is employed, except in heavy-gage plate work. A short gap between rod and work enables flux protection to be maintained. Weaving, except for wide beads, is avoided. A weld must be made on clean metal, and rods must be clean and dry.

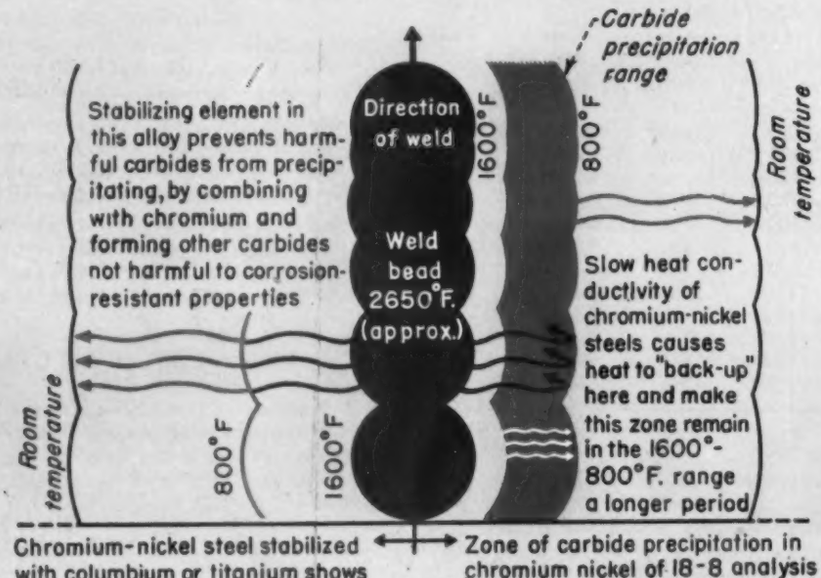
CHROMIUM-NICKEL STEELS. The low heat conductivity of chromium nickel steels tends to cause a back-up of heat to the molten pool of welding metal, causing its adjacent areas to be held in the critical range of 800-1600 F. Carbide precipitation then takes place on two bands parallel to the bead, one on each side of and close to the welding bead, and it is along these boundaries that intergranular corrosion takes place. Stabilizing chromium-nickel prevents this and is particularly desirable where heavy sections are to be welded.

Butt welds are readily made in all thicknesses of stainless down to about No. 20 gage with metallic arc. Below No. 16 gage and down through No. 24 gage, welding machines are especially constructed for light-gage welding. On thicknesses up to No. 10 gage, a straight shear-cut is used. On lighter gages, the edges may be set-up without a gap—actually touching each other.

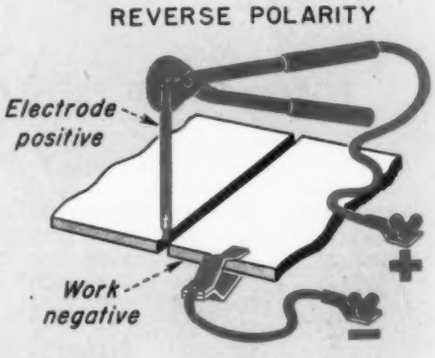
Thicknesses over No. 10 gage are generally bevelled to a 30° angle on each side of the section, leaving the bottom of the V about 1/32 in. or 1/16 in. above the bottom of the joint. Many fabricators use a U-shape groove on stock over 5/8 in. Thicknesses of 3/16 in. are generally the maximum that can be welded with one pass of the arc.

In light-gage work, it is sometimes advisable to weld a butt joint from both sides, the first bead supplying the major portion of strength. The second and lighter bead is laid in as a stringer bead, with emphasis on uniformity rather than strength. This second bead would have less carbide

CARBIDE PRECIPITATION CAUSES


Carbide precipitation range
Stabilizing element in this alloy prevents harmful carbides from precipitating, by combining with chromium and forming other carbides not harmful to corrosion-resistant properties
Direction of weld
1600°F
800°F
Room temperature
Weld bead 2650°F. (approx.)
Slow heat conductivity of chromium-nickel steels causes heat to "back-up" here and make this zone remain in the 1600°-800°F. range a longer period
Room temperature
800°F
1600°F
Chromium-nickel steel stabilized with columbium or titanium shows no area of harmful precipitation
Zone of carbide precipitation in chromium nickel of 18-8 analysis caused by welding heat

REVERSE POLARITY



ARC WELDING—CHROMIUM-NICKEL STAINLESS

Metal Thickness	Electrode Diameter, In.	Amperage	Voltage Open-Circuit
0.050 in. and lighter.....	5/64	25-50	30-35
0.050-0.0625 in.....	3/32	30-90	35-40
0.0625-0.140625 in.....	3/32-1/8	50-100	40-45
0.140625-0.1875-3/16 in..	1/8-5/32	80-125	45-50
0.250 in. and heavier....	3/16	100-175	55-60

precipitated along its grain boundary and should be placed on the side of the sheet to be exposed to corrosive agents. Where multiple beads are necessary, they should be laid down in a succession of light beads rather than in one or two heavy beads. With successive beads, each layer should be cleaned with a stainless steel wire brush. The first layers can also be peened with a blunt tool to help relieve stresses. Because of the successive heating and slow cooling of the initial layers, the use of stabilized chromium-nickel steel and rod is even more desirable.

Alignment of joints for welding may be maintained by either tacking or welding jigs which may be supplemented by cooling devices. On light gages, tacks may be small and spaced about 1 in. apart. For 2-sided welding they should be placed on the side opposite the first bead. On deep-groove work, tacks may be either on the bottom side of the joint or deep in the groove.

Cooling bars may be placed on either side of the point of the upper surface and a combination cooling and backing-up bar at the bottom to effect rapid cooling and absorb excess heat. Copper is used to compensate for the low heat conductivity of stainless. A slight increase in molybdenum in chromium-nickel steels gives a better balanced alloy for welding but will also be a little stiffer to handle.

Welding currents will be lower than for plain carbon steel of equal thickness. Actual current settings also depend on the machine, speed along the joint and upon the cooling arrangements. For general guidance a good starting point is about 10% less than carbon steel. For stainless, the arc should be as short as possible. Correct voltage is indicated if a slight withdrawal breaks the arc.

STRAIGHT CHROMIUM STEELS.

These steels differ from chromium-nickel grades in that they are: Not subject to carbide precipitation adjacent to welds, being stable at all temperatures.

Sometimes characterized by brittleness, due to air-hardening characteristics or increase in grain size. This brittleness may be corrected by subsequent heat-treatment.

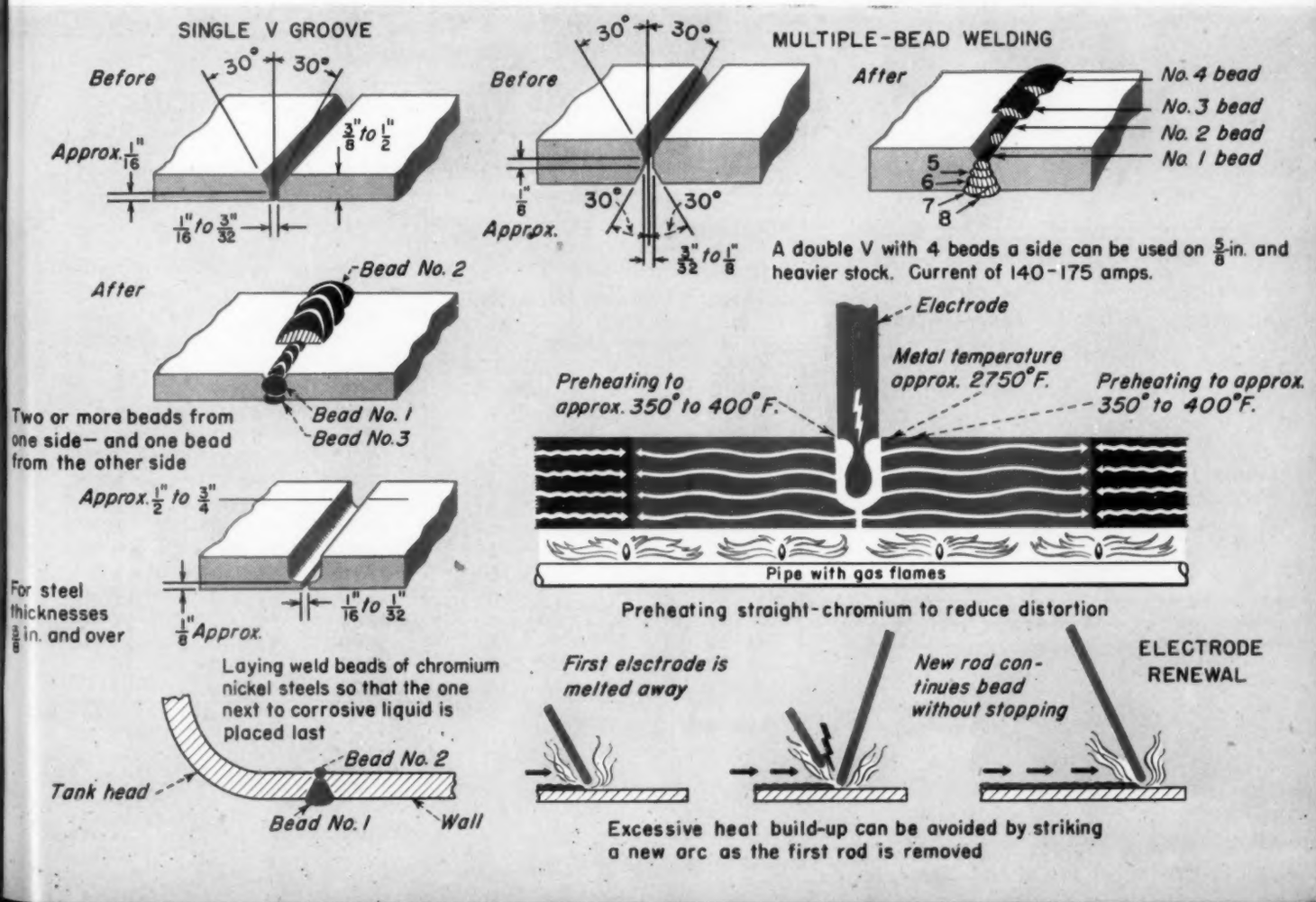
Steels containing over 16% chromium are sometimes used in high-temperature service, which helps to improve their ductility. The general welding procedures for chromium-nickel types apply also to straight chromium steels. Pre-heating of straight chromium to 350-400 F. and post-heating to slightly higher temperatures relieves built-up stresses. Post-heating may take the form of a local anneal, in which an acetylene torch traverses the weld deposit at about 1200 F., followed by air-cooling of the deposit.

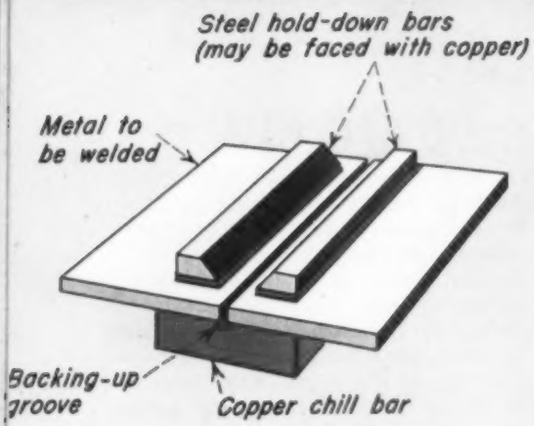
Chromium-nickel rods have been used in welding straight chromium to increase ductility in the bead. Where necessary, the weld has been finished with a light bead of straight-chromium electrode after the main weld has been made. Rods of the 25-20 chromium-nickel analysis have a coefficient of expansion nearest that of straight chromium and are sometimes more suitable.

ATOMIC-HYDROGEN WELDING.

This process is employed on all types of thin-gage stainless steel. Butt, lap, fillet and raised edge joints similar to those for arc and gas torch are readily produced. An uncoated filler rod is used where additional metal is required. Analysis is the same as the base metal, with a slight increase of carbon.

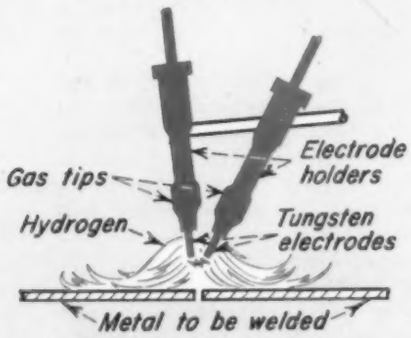
Greater heat of the atomic-hydrogen method permits faster travel and there is reduced danger of carbon pickup. Carbide precipitation must be guarded against, as in other forms of welding. The process lends itself to automatic operations, particularly for straightaway or circumferential joints. Beads deposited are characterized by good physical properties, soundness, freedom from scale and smooth surface. Stabilized alloys and rods are naturally preferred types.



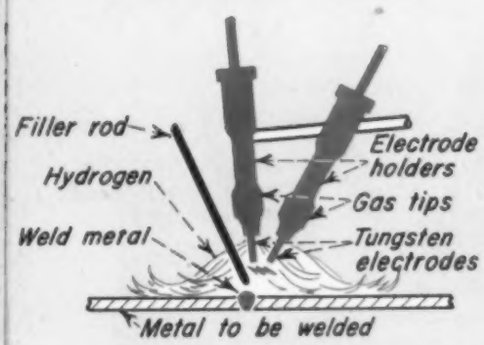


Hold-down bars and chill bars reduce distortion, particularly in straight-chromium stainless

ATOMIC HYDROGEN WELDING

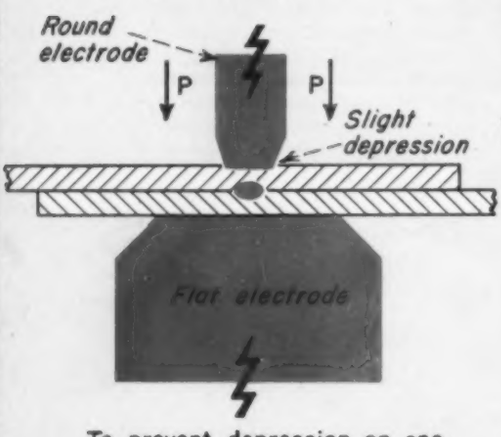


Atomic welding of light gages



A filler rod is used in atomic hydrogen welding of heavy gages

SPOT WELDING



To prevent depression on one side of sheet use a flat electrode

RESISTANCE WELDING. Electrical resistance methods are eminently suitable to the joining of chromium-nickel steels. Electrical resistance of the steel is high (six or more times that of steel) and heating is rapid and confined to a limited area, minimizing tendencies toward warping. The current is lower than with mild steel and flows so short a time that carbide-precipitation tendency is decreased.

Because of the considerably lower heat conductivity of stainless, the thermal gradient is much steeper than with mild steels and the weld is more susceptible to variation in magnitude and time of welding current, welding pressure and tip shape.

Welding current should always be applied on the same point of the voltage wave and voltage regulations at the welding transformer should not be more than 5%. No auto-transformers should be used between the welding transformer and the welding contactor.

Welding at time intervals of less than 5 cycles (1/12 sec.) should not be attempted unless timing accuracy of better than ¼ cycle (1/240 sec.) can be assured. With very thin gages, where it is desirable to use short time intervals, timing equipment of the full electronic type and independent of mechanical switching of current, should be used. A timing variation of more than 1 cycle (1/60 sec.) in duration of weld is not advisable.

Electrode pressure is two to three times higher than with mild steel and should be uniform, as any variation will affect both current density and electrical resistance of the weld. Adequate jigs should be provided to hold the surfaces together and relieve the welding arms from the need of flattening out ripples and buckles. Lack of sufficient pressure aids development of blow holes inside the weld and, in extreme cases, in actual surface fusion of the metal.

Because of the comparatively high contact resistance of high-tensile chromium-nickel steels, the short-circuiting effect of the preceding welds on each new weld may be considerable, particularly if more than three metal thicknesses are welded together at a time and if the spacing of spot welds is comparatively close. This should be measured and compensated for by a suitable increase of welding current.

For best results, electrode tips should be of special copper alloys having at least 70 Rockwell B hardness and 85% electrical conductivity. They should be designed to operate at low temperatures, either by use of water cooling or refrigeration. When very slight indentation is required on one side of the weld, a flat block of copper (about 2 in. square by ½ in. thick) may be used as one electrode.

Projection spot welding, multiple spot welding and line seam welding are all successfully applied to stainless with equal consideration of the above variables. Seam welding, be-

APPROXIMATE SPOT-WELDING CONDITIONS

Chromium-Nickel (90-100,000 psi.) For Two Thicknesses

Thickness of Thinner Sheet, In.	Electrode		Weld Pressure, lb.	Weld Current, Amp.	Weld Time, Cycles
	Diam., In.	Dome Radius, In.			
0.006	5/8	1/16-Flat 30°*	100	1750	2
0.010	5/8	3/32-Flat 30°*	175	3100	2
0.016	5/8	1	278	4750	3
0.020	5/8	1	350	5700	4
0.030	5/8	2	500	7200	4
0.040	5/8	4	750	8400	5
0.050	5/8	4	1000	9200	8
0.062	5/8	6	1300	10,000	8
0.072	3/4	6	1600	10,500	8
0.081	3/4	6	1850	11,000	12
0.093	3/4	6	2200	11,700	12
0.109	3/4	6	2500	12,600	15
0.125	1	8	3000	13,500	15
0.157	1	8	4300	14,700	20
0.187	1 1/4	10	5500	16,000	25

*Approach

SEAM-WELDING 18-8 STAINLESS

Sheet Thickness, In.	Wheel Face, In.	Speed, In./Min.	Pressure, Lb.	Current, Amp.	Time Cycles	
					On	Off
0.005	1/8	30	650	12,500	1	5
0.020	1/8	30	900	8,640	2	3
0.025	3/16	72	750	6,300	2	2
0.035	3/16	60	1000	7,500	2	4
0.049	1/4	36	1150	8,600	3	7
0.062	—	30	1400	9,500	3	9

cause of cumulative heat buildup, requires added cooling precautions.

FLASH WELDING. As compared to spot and seam welding, flash welding is practiced on butt-to-butt or edge-to-edge welding instead of overlapping pieces of stainless steel. Heat required to flash-weld chromium nickel is about 15% less than that required for mild steels and the time one-half. The amount of metal extended beyond the gripping copper dies should be less than that for mild steels. When the weld is completed, there should not be more than 1/16 in. between the inside faces of the gripping dies.

FLASH-WELDING CURRENT REQUIREMENTS

Area of Joint, Sq. In.	KVA.
0.05	10
0.10	15
0.25	20
0.50	25
0.75	30
1.00	35
1.25	40

DISSIMILAR METALS. Welding of stainless steels to mild steels can be accomplished if stainless electrodes and filler rods are used. Procedures under gas or arc weld are suitable for this type of welding. Inasmuch as a lowering of chromium and nickel must take place by admixture of mild steel, the weld metal may become air-hardened and deficient in corrosion resistance. By altering the position of the welding electrode, it is possible to regulate its fusion and the proportions of chromium and nickel that are fused into the joint. Naturally, the longest dwell should be on the chromium-nickel side of the joint.

HELIUM ARC WELDING. High welding speeds, with good weld quality, are possible with the helium shield process, particularly in stainless sheet up to 0.062 in. High ductility in the weld is maintained by the helium shield. Loss of titanium in 321 grade stainless does not affect weld strength because a slight decrease in carbon maintains the titanium-carbon ratio.

Conventional dc. motor-generator arc-welding units, using negative polarity on the carbon electrode are used. From 5/8 in. to 3/4 in. of electrode end is ground to a 1/16-in. to 3/32-in. diameter to obtain better control of the arc. This shape permits welding for a considerable length of time without regrinding. Helium flow of 5 liters per min. is satisfactory.

Parts may be fluxed lightly between flanges (flange radii should be approximately 1/16 in.). Fluxed welds are cleaned, pickled for 20 min., stabilized and sandblasted. Welding may also proceed without flux, using a copper backup plate to exclude air and serve as a chill. Unfluxed welds may be heat-treated and sandblasted.

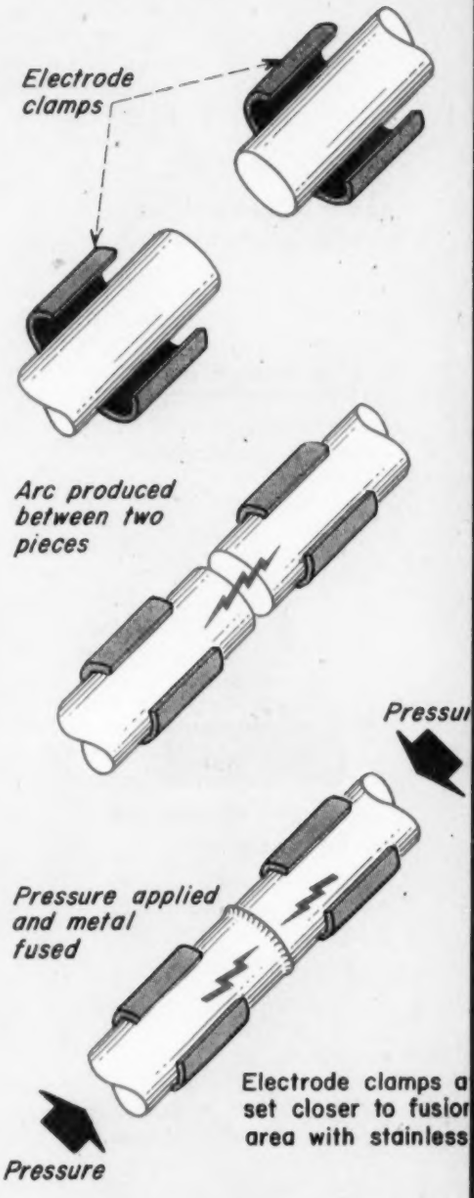
OXYACETYLENE WELDING. Acetylene welding is successfully used on chromium-nickel, especially the lighter gages (No. 18-20 and lighter). Flame should be as small as possible and tips about two sizes smaller than for mild steel are recommended. By

TYPICAL WELDING ROD ELEMENT LOSS IN 18-8*

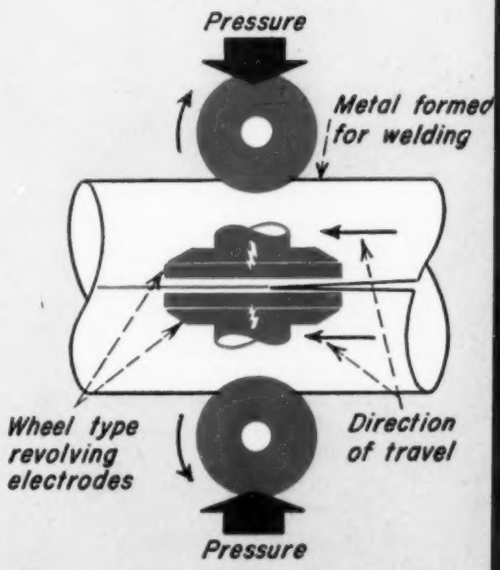
Element	Percent In Rod	in Weld Deposit
Chromium	19.0	18.0
Nickel	9.0	9.0
Columbium	1.25	0.90-0.85
Titanium	Is not used in rods because it would be lost	
Molybdenum	3.5	3.5
Phosphorus	0.03	0.03
Carbon	0.08	0.08

*Approximate figures—flux in electrode is a variable.

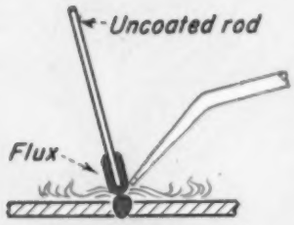
FLASH WELDING



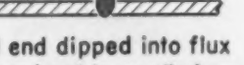
SEAM WELDING



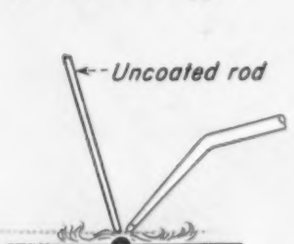
Seam welding with double wheel electrodes



Rod end dipped into flux before heat is applied

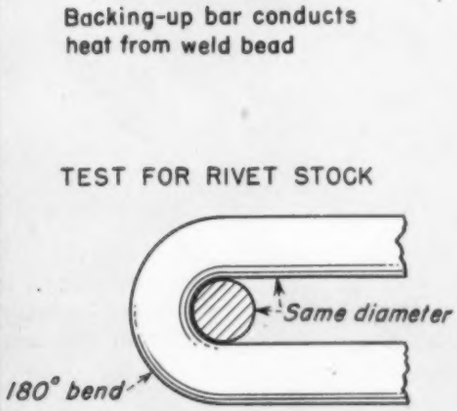


Flux painted on weld joint before torch is applied

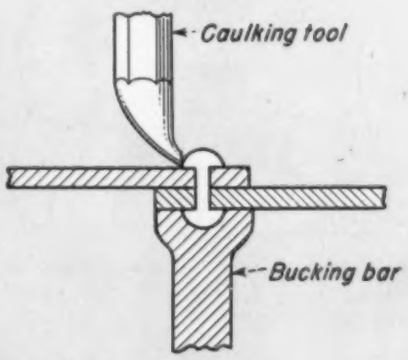


Backing-up bar conducts heat from weld bead

TEST FOR RIVET STOCK



CAULKING LIGHT-GAGE SHEET



keeping the tip pointed down the joint in the direction of the weld, a certain amount of desirable preheat is obtained ahead of the puddle. This also keeps heat off the deposited head and allows it to cool more rapidly.

An exactly neutral flame is ideal for welding stainless, and any slight variation should be on the reducing side. If too much acetylene is used, carburization of the weld takes place, making it brittle and lacking in corrosion resistance.

RECOMMENDED OXYACETYLENE ROD SIZES

Thickness	Rod Diam., in.
18 gage and lighter	1/16
18 to 16 gage	1/16 to 3/32
16 to 10 gage	3/32 to 1/8
10 gage to 3/16 in.	1/8 to 5/32
1/4 in. and heavier	3/16 to 1/4

The use of heavy chill bars and clamping devices improves welding of stainless by this method. While the flame protects the molten bead on the upper side against oxidation, a flux should be applied to the under side close to the edges being welded. Fluxes are in the form of paste, and may be brushed over the surface and allowed to dry. Rod ends may also be dipped in them. The addition of 20-25% Cryolite to some of the commercial fluxes, mixed to a thin paste with water and applied to electrode by dipping, will make any infusible slag resulting from the welding of titanium-bearing alloys fluid. With such fluxes, the flame should be slightly oxidizing rather than neutral. Welding should be rapid, with minimum heating of adjacent metal.

RIVETING

Regardless of the grade of stainless used, only smooth, centerless-ground or cold-drawn rivet stock of fine-grained structure should be used. Finished rivet stock should be capable of withstanding a cold 180° bend around a mandrel of the same diameter as the stock.

Holes for riveting should be drilled rather than punched to avoid excessive stress. Small rivets, up to about 1/4-in., of chromium-nickel may be driven cold, but heavy pressures are necessary and the head should be finished in one or two blows. Larger rivets are hot-driven at about 2000 F. and completed as rapidly as possible to avoid work-hardening.

Rivets up to 3/8 in. dia. in straight chromium may be headed or upset cold with a hydraulic riveter. Straight-chromium rivets should not be heated above 1450-1500 F. for hot hot driving, because of air-hardening and grain growth. Straight-chromium stainless steels must be caulked carefully, as they have a tendency to flake off at the edges. On light-gage work the caulking tool should be opposed by a "backing-up" bar held against the seam from opposite side.

SOLDERING

Soft-soldering stainless is useful where corrosive conditions are extremely mild and where strength requirements are not high. White pickle finishes (No. 1) provide best adhesion, while polished finishes must be roughened by grinding wheel or coarse emery paper. Fluxes prepared specifically for stainless steels remove surface oxide and permit adhesion. A large soldering iron is necessary because of the relatively low thermal conductivity of stainless. A longer time is required to bring the metal up to soldering heat.

Ordinary 50-50 lead-and-tin solder has been used, but if polished sheets are to be joined, a higher-tin mixture, 80-20, will have less tendency to discolor. This is almost becoming standard practice, because of cleanliness and strength. After soldering, all traces of acid or flux are removed by swabbing with a dilute alkaline solution, such as 5-10% solution of washing soda, followed by rinsing in clean, hot water.

Hard, or silver, soldering, is especially useful in joining non-ferrous metals to stainless steels and is practical for making joints where welding is not feasible. The joint should be preheated with oxyacetylene torch and flux applied before the metal surface becomes oxidized. Any oxide formed on the stainless steel should be removed by local pickling or light grinding and polishing. When stainless is soldered to metals with greater conductivity, the torch flame is directed on the foreign metal to secure a firmer bond. Silver solders can be obtained with melting points ranging from 1100 to 2000 F. The choice of solder is determined by such requirements as color matching, maximum temperature to which base metal may be heated, and joint strength required. With unstabilized steels, carbide precipitation in the base metal must be carefully checked. With stabilized stainless, the melting point of the solder is immaterial.

COLD-WORKING

DRAWING. High ductility of chromium-nickel stainless provides good deep-drawing qualities, but the high strength and tendency to work-harden indicates modified procedures and greater power requirements. Straight high-chromium steels of lower ductility and tendency to become brittle at high temperatures, can be drawn, but may require more intermediate annealing.

Because chromium-nickel stainless work-hardens, it is necessary to use a lower press speed, say a conservative rate of 25 to 30 fpm. Recently, a number of fabricators have increased speeds to as high as 50 fpm. by careful attention to die design, lubrication and close annealing control. However, for average practice, a lower speed will be safer and prevent the metal from being drawn too rapidly into the die.

Reductions as high as 50 to 55% have been made under certain conditions, but the normal drawing reduction in the initial draw is about 40%. This varies with gage and diameter of blank. On 14-gage, 18-8 stainless with a blank diameter of over 36 in., 30 to 35% is a safe limit. Subsequent draws will be between 20 and 25%, depending on size of blank and material being handled. Straight-chromium steels can be reduced about 20-25% in the first operation. For extra deep-drawing qualities, a hardness not exceeding 80 Rockwell B is desirable.

Solid dies of the high-carbon, high-chrome composition are suitable for drawing chromium-nickel. Chromium-nickel cast-iron dies stand up well for severe reductions on fairly long runs. Tungsten-carbide dies just recently have been tried for long-run drawing of smaller parts by several large fabricating companies who report good working characteristics and exceptionally long tool life. On larger parts, tungsten-carbide inserts are being used on draw rings, but cost is high and breakage possible. Cast-iron tools are suitable for short-run work on the lower-tensile stainless steels.

Hard cast bronze of 300-325 Brinell hardness is almost a standard draw-ring material with many companies. The centrifugally cast grade has longer life. Chromium-nickel cast-iron draw rings are recommended by certain press manufacturers and fabricators for long-run drawing. Polishing of both the draw ring in the direction of drawing is recommended, and a growing practice is to stone the draw ring on the radii. Improved finish and more pieces between grinds has resulted. At the first sign of metal pick-up it is advisable to stone tool surfaces.

Preheating the dies to about 200 F. increases the ductility of straight-chromium steels and makes them more adaptable to deep-drawing operations.

Draw-ring radii should be 4 to 6 times the thickness of the steel. This avoids stretching the metal and allows it to flow more freely into the die, at the same time decreasing the rate of work-hardening. Occasionally, because of the high elastic limit of stainless and design of the part, the final anneal may be followed by a re-striking operation. Provision for a self-centering punch and die prevents distortion and scoring of the work by eliminating side play and maintaining original clearances.

Failure thoroughly to remove all lubricants before annealing results in formation of a crusty scale. Lubricants may be removed by benzine, followed by suitable alkali cleaning solutions at boiling temperature. A high rate of evaporation is desirable. If an oil-soluble lubricant is used, cleaning may be done with a degreaser.

For a first operation, with a moderate draw, the punch diameter may be 60% of the blank diameter. Following draws are made, after intermediate cleaning and annealing, with punches approximately 20% smaller in diameter for each successive operation. Sequence of punch diameters will be determined more closely when all variables are accounted for. If distortion appears in the part after the final anneal, it may be necessary to reduce the severity of draws or add an additional one. Many fabricators report that they have made as many as 3 or 4 draws before giving an anneal. Shop variables will determine the frequency of anneals.

DRAW ROLLING. Chromium-nickel parts, such as short channels and angles, required in comparatively small lots or unsuitable for hot rolling, may be pulled or drawn through idle hardened-steel forming rolls. The only strain on the metal is that of forming and there is no dragging and sticking as when drawing the steel through a fixed die. Fixed dies, however, may be used for straightening and maintaining the shape of the interior of the section.

Cold-rolled 18-8 strip, with tensile strengths of 180,000 psi., may be draw-rolled successfully in gages from 0.002 to 0.030 in. in practically any form. It is advisable to design symmetrical sections and simple forms which may be joined together by spotwelding into more complicated structural members.

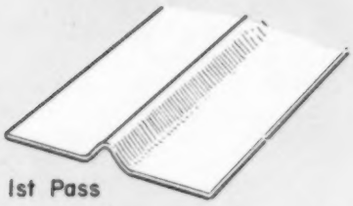
For average jobs, rollers may be of a good grade of hardened tool steel and for severe forming high-speed steel, case-carburized should be used. Roll diameters up to 6 in. are used with three sets of rolls, mounting each set of rolls in a separate frame

DRAWING CLEARANCES AND RADII FOR STAINLESS STEELS

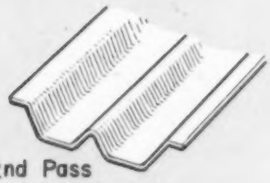
Metal Thickness		Chromium-Nickel			Straight Chromium		
Ga.	In.	Die Clearance In.	Die Radius In.(1)	Punch Radius In.(2)	Die Clearance In.	Die Radius In.(1)	Punch Radius In.(2)
30	0.0120	0.0144	0.0600	0.0360	0.0138	0.0480	0.0264
28	0.0149	0.0178	0.0745	0.0447	0.0171	0.0596	0.0328
26	0.0179	0.0215	0.0895	0.0537	0.0205	0.0646	0.0471
24	0.0239	0.0287	0.1195	0.0717	0.0280	0.0956	0.0526
22	0.0299	0.0359	0.1495	0.0897	0.0344	0.1196	0.0658
20	0.0418	0.0431	0.1795	0.1077	0.0413	0.1436	0.0790
18	0.0500	0.0600	0.2390	0.1434	0.0550	0.1913	0.1052
16	0.0598	0.0738	0.2990	0.1794	0.0688	0.2392	0.1316
14	0.0747	0.0896	0.3735	0.2241	0.0859	0.2988	0.1643
12	0.1046	0.1255	0.5230	0.3138	0.1202	0.4184	0.2301
10	0.1345	0.1614	0.6725	0.4035	0.1547	0.5420	0.2959
8	0.1644	0.1973	0.8220	0.4932	0.1891	0.6576	0.3617
6	0.1943	0.2332	0.9750	0.5829	0.2234	0.7772	0.4275
4	0.2242	0.2690	1.1210	0.6726	0.2578	0.8968	0.4932

Note— (1) For first drawing operation.
(2) This dimension dependent on design requirements.

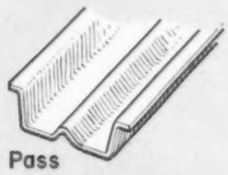
DRAW ROLLING



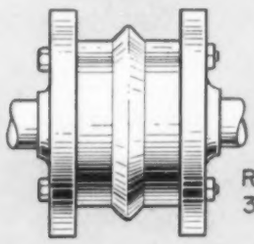
1st Pass



2nd Pass



3rd Pass



Roll for 3rd Pass

or housing to provide for individual adjustments. Either horizontal or vertical roll axes may be used.

Bends of more than 45° should not be attempted in a single pass. Formation of a section is begun at its middle part with the first set of rolls, working outwardly toward the edges of the strip. The converse radius on the roll determines the degree of curvature secured on the bead. In forming V-shaped beads, all forming is done on the convex rolls, the opposing rolls having a contour designed to allow ample clearance for the formed bead. Springback difficulties in chromium-nickel are avoided by small radii of curvature and by variations in allowable clearances between rolls.

Edge guides are only used in the first pass, as the bead formed in this operation is used to guide the partially formed section through successive rolls. Rolls may be solid, although greater flexibility may be obtained by using built-up dies.

Drawing speeds of 40 to 60 fpm., furnished by an electric motor, give good results. Shear pins on the benches will break if jamming occurs and prevent damage to spindles and gears. Vibration is avoided by mounting rolls near the end of the bench.

A minimum clearance of 0.002 in. is allowed on rolls at all points. Stainless-steel strip is first passed through an edge trimmer made from a series of hardened steel disks mounted perpendicular to the strip plane, then passed through a wiper. The strip enters a guide, placed close to the first set of rolls, which are separated to receive the strip, and then tightened gradually as the strip passes through. This is repeated with the other rolls until the shape is fully assumed. After leaving the finishing rolls, camber or twist in the formed section can be corrected by alignment of rolls or a straightening device made of two lubricated wooden halves, shaped to conform to the finished section.

BLANKING AND PUNCHING. Power requirements for blanking and punching stainless will vary in proportion to the shear strength of the materials being worked. The chromium-nickel types of lower tensile strength (approx. 100,000 psi.) will require at least 40% more power than similar thicknesses of mild steel. Speeds should be lowered to about two-thirds that required for mild steel. As straight chromium steels break out about the same amount as mild steels, dies and punches may be set conventionally.

In blanking and punching, as in shearing, the clearances for chromium-nickel steels should be set closer

PUNCHING PRESSURE FOR 18-8 STAINLESS*

Thickness, Gage	Hole Diameter, in.														
	1/8	3/16	1/4	5/16	3/8	7/16	1/2	9/16	5/8	11/16	3/4	13/16	7/8	15/16	1
20	0.43	0.80	1.07	1.32	1.60	1.80	2.10	2.40	2.70	2.90	3.15	3.45	3.75	4.05	4.20
18	0.71	1.06	1.41	1.80	2.10	2.55	2.75	3.15	3.60	3.90	4.20	4.65	4.95	5.25	5.70
16	0.89	1.34	1.80	2.25	2.70	3.65	3.60	4.05	4.35	4.80	5.25	5.70	6.15	6.60	7.05
14	1.11	1.65	2.25	2.75	3.30	3.90	4.35	4.95	5.55	6.10	6.60	7.20	7.80	8.25	8.85
12	1.50	2.40	3.15	3.90	4.65	5.40	6.15	7.05	7.80	8.55	9.30	10.05	10.80	11.55	12.45
11	1.80	2.70	3.60	4.50	5.25	6.15	7.05	7.95	8.85	9.75	10.65	11.55	12.45	13.20	14.10
10		3.00	4.05	4.95	6.00	6.90	7.95	9.00	9.90	10.95	12.00	12.90	13.95	15.00	15.90
3/16"		4.20	5.55	6.90	8.25	9.75	11.10	12.45	13.80	15.30	16.65	18.00	19.35	20.70	22.20
1/4"			7.35	9.30	11.10	4.30	14.70	16.50	18.45	20.25	22.20	24.00	25.80	27.75	29.55
3/8"					16.65	19.50	22.20	24.90	27.75	30.45	33.15	36.00	38.70	41.55	44.25
1/2"						25.80	29.55	33.15	36.90	40.65	44.25	48.00	51.60	55.35	59.10
5/8"									46.20	51.70	55.35	60.00	64.50	69.15	73.80
3/4"											66.45	72.00	77.55	83.10	88.50

*Shear strength—75,000 psi. Punching pressure in tons.

than for mild steels. Clearance for light-gage stainless should be between 0.0015 and 0.0025 in. maximum. For heavier gages, clearances of 0.0025 to 0.0040 in. are considered good practice.

Shear of the punch should not be too great, but should put the metal in a slight state of tension just before cutting begins. Present shop practice indicates that the shear is no greater than the thickness of the metal. Because of the higher ductility and elongation of chromium-nickel grades, the shear may be slightly increased over standard mild steel practice to provide a slight breaking-through and speed the cut. Both die and punch may be made of the same type of steel, either an air- or an oil-hardening tool steel being preferred.

In one-level punching of holes, suggested pressures may be multiplied by the number of holes to be punched. The resultant tonnage should not exceed about two-thirds the rated capacity of the equipment. If punches are stepped one-half of the metal thickness, or more, the total pressures can be divided by the number of steps attained.

By reducing press speed to about one-half to one-third of mild-steel practice and increasing the power at least 75%, stainless steel can be satisfactorily perforated. It is inadvisable to attempt to perforate straight chromium steels where the holes are smaller in diameter than stock thickness, or chromium-nickel steels where diameter of the holes is less than 1½ to 2 times metal thickness. After perforating, it may be necessary to flatten or anneal the work for certain applications.

SPINNING. More turning power at the lathe head is required for spinning stainless steel than for mild steel, and generally it is not spun to as great a depth. Spinning speed for chromium-nickel steels is usually ¼ to ½ the speed for dead-soft copper. Straight-chromium grades may be worked at about 2/3 the speed used for spinning mild steel.

While it is desirable to do the maximum amount of spinning before the first anneal on chromium-nickel grades, average shop practice indicates that it can proceed about 1/3 as far as mild steel. Wherever possible, it is good practice to leave 1 or 2 in. of rim metal unworked until the operation is nearly complete. This prevents cracking or splitting from the edge.

Spinning tools are preferably of the roll type, and are made of hardened alloy steel or chromium-nickel cast iron. A greater bearing surface than is customary with softer metals is desirable. Stoning of this surface extends tool life and leaves a better finish on the work. It is good practice, if design of the part permits, to subject the metal only to tensile stresses, as compressive stresses make operation more difficult.

Lubricants of fairly high viscosity with extreme pressure additives are recommended for severe deformation. Water-soluble lubricants and white laundry soap may be used on lighter gages and moderate deformation, but should be applied liberally. As with other fabricating processes, thorough cleaning should precede annealing.

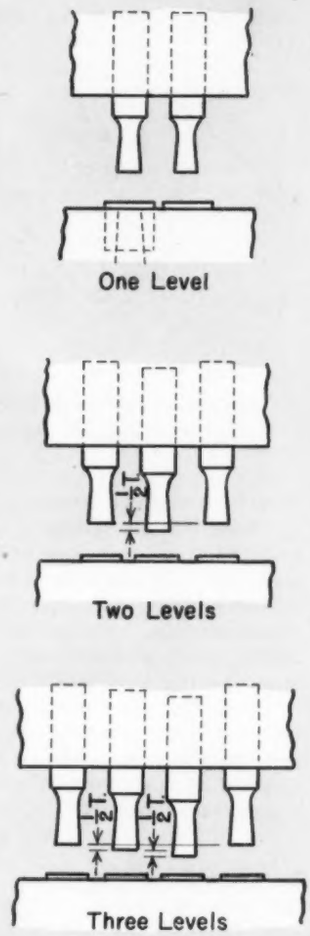
SHEARING. Stainless steels, particularly the chromium-nickel types, call for a more powerful shearing action than mild steel. Current practice is to use shears about 4 to 5 gages heavier than those used for mild steel, at the same time slowing down the speed by about 25%. Equipment with hydraulic holddowns is desirable for shearing polished stainless, and the pressure may be reduced where good surface finish must be maintained.

High-speed-steel knives of high quality give best results and a low rake or shear of about 1½° on the upper knife is preferable. Knives should be ground with a lip clearance as great as can be maintained without chipping. Straight-chromium steels will break out much in the same manner as mild steel, after about 50% of their thickness has been cut.

Because of their high physicals and work-hardening characteristics, the chromium-nickel steels require a close adjustment of the knives and maintenance of a sharp cutting edge at all times. Dull knives or too great a clearance will tend to twist the sheet, drag it over the edge in a drawing action and make the cut extremely difficult to complete. The cut should be as continuous as possible, with no attempt to chop through.

Standard commercial nibbling machines are suitable for cutting irregular or special shapes from light plates and sheet. Mechanical feeding devices and treadle operation facilitate this type of cutting.

BENDING AND FORMING. Bending and forming equipment, rated at a definite capacity for mild steel, is limited to stainless steel several gages lighter. Aside from the added power and reduced speed for chromium-nickel steel, increased springback must be compensated for in design

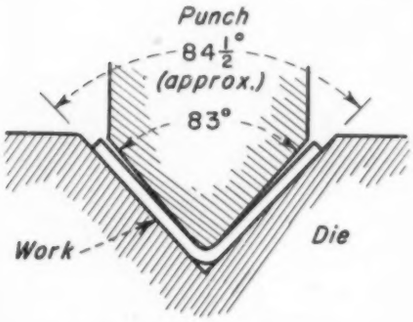


By stepping punches one half the thickness of the metal required, punching pressure is reduced.

SHEARING CLEARANCE FOR 18-8

Metal Thickness Gage	Metal Thickness In.	Clearance In.
20	—	0.0018
19	—	0.0021
18	—	0.0024
17	—	0.0027
16	—	0.0030
15	—	0.0034
14	—	0.0037
13	—	0.0045
12	—	0.0052
11	—	0.0060
10	—	0.0067
9	—	0.0075
8	—	0.0082
—	3/16	0.0094
—	1/4	0.0125
—	5/16	0.0157
—	3/8	0.0187
—	7/16	0.0219
—	1/2	0.0250
—	5/8	0.0313
—	3/4	0.0375
—	7/8	0.0437
—	1	0.0515

SPRING-BACK ALLOWANCE



Added spring-back allowance must be made for stainless

of the tools. Springback is overcome by bending the work to an angle greater than that desired. Angular springback is sometimes avoided in thick metals by rounding the V in the die to conform with the outside bend in the work, as sketched. The sharp angle on the punch is made about 1 to 2° less than the die angle for conventional 90° bends. The punch in coming down then scores a line in the finished bend and sets the metal over a positive support.

COLD HEADING. Most grades of stainless steels are well adapted to cold heading for the production of bolts, nails, rivets, cotter pins, screws and similar products. Usual practice is to cold-head the straight-chromium types up to a maximum of ⅝-in. bolt diameter, and the chromium-nickel types up to 7/16-in. diameter. Diameters larger than this are generally hot headed. For cold-heading, stainless steels are furnished in coils properly annealed and supplied with a lubricant coating.

When cold-heading, it is preferable to use a size larger heading machine than would be required for the same size in mild steel. Dies may be either closed or open, except in the case of the free-machining types, for which closed dies are preferred.

General manufacturing sequence in the production of bolts and screws by the cold process is to cold-head, then pickle, tumble and passivate, to get a clean surface for subsequent threading. Threading is again followed by passivating. Some fabricators introduce an anneal after heading in order to eliminate the effects of cold working, and then proceed as above. Straight chromium alloys are usually upset to 170% of the bolt diameter, as compared with about 140-155% for the chromium-nickel alloys.

Nuts are made principally from the free-machining alloys. Small nuts for screws and stove bolts are cold punched from small flats and tapped. Larger nuts are machined from cold drawn or hot rolled, annealed and pickled bar stock of desired section.

WE ACKNOWLEDGE...

The suggestions and technical information contributed by producers and fabricators of steels and working equipment have been of great assistance in preparation of this section on stainless-steel practice. Among these companies are:

American Iron & Steel Institute
Air Reduction Sales Co.
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Abrasive Company
Allegheny Ludlum Steel Corp.
E. W. Bliss Company
Carborundum Company
Carboloy Inc.
Carpenter Steel Company
Carnegie-Illinois Steel Corp.
Chambersburg Engineering
Crucible Steel Co. of America
Cincinnati Shaper Company
Eastern Rolling Mill Company
Electro Metallurgical Company
Firth-Sterling Steel Company
Hanson Van Winkle Munning Company
Handy and Harman
Hydraulic Press Manufacturing Co.
Industrial Steels, Inc.
I-T-E Circuit Breaker Co.
Jessop Steel Company
Lincoln Electric Company
The Linde Air Products Company
Lalance & Grosjean
Norton Company
National Twist Drill Company
Pressed & Welded Metals, Inc.
Rustless Iron & Steel Dv.
Republic Steel Corp.
Joseph T. Ryerson & Son, Inc.
Resistance Welders Association
Square D Company
Sharon Steel Corporation
United States Steel Corp.
Various press, machine-tool, oil, abrasives, welding-equipment, and tool producers.

BENDING PRESSURE FOR 18-8 STAINLESS STEEL* PER

Thickness	Width of V-Die Opening, Inches																		
Gage	¼	5/16	⅜	7/16	½	⅝	¾	⅞	1	1⅛	1¼	1½	2	2½	3	4	5	6	7
20	4.85	3.5	2.6	2.1	1.7														
18	8.0	6.0	4.5	3.8	3.3	2.6	2.0												
16	14.4	10.7	8.4	6.7	5.7	4.2	3.3	2.7	2.3										
14		17.9	13.8	11.4	9.5	7.1	5.3	4.5	3.8	3.2	2.7								
12				25.1	19.7	14.6	12.0	9.8	8.5	6.9	6.2	4.8							
11					28.8	21.3	16.7	13.6	11.3	9.5	8.3	6.6	4.4						
10						27.9	21.8	17.9	14.9	12.8	11.0	8.7	6.0						
3/16"							41.1	34.6	29.0	24.6	22.0	16.3	11.3	8.6	6.6				
¼"									59.1	49.9	44.3	34.1	23.1	7.1	13.5	9.2			
5/16"											75.6	59.7	40.5	29.6	23.0	15.8	11.6		
⅜"												92.4	63.5	26.4	36.0	24.5	18.5	14.3	
7/16"													92.6	73.7	53.1	36.6	27.0	22.2	26.8
½"													132.8	95.4	73.2	50.0	36.9	29.1	23.9
5/8"														165.0	129.4	87.5	64.6	50.0	41.1
¾"															207.0	139.5	103.1	80.3	65.4
⅞"																205.5	156.0	121.1	96.9
1"																295.5	214.5	169.5	136.8

*Rated in tons for 90,000-psi. tensile-strength material. Correction factors may be added for increased tensile strengths

FINISHING

GRINDING. Solid wheels will give the best results when sharp cutting is required to clean up welding beads and to remove pits and imperfections from the surfaces of sheets, plates, bars and tubular products. Because of the low rate of heat dissipation and high coefficient of friction of stainless, it tends to overheat under the wheel. The wheel must not dwell, and coolant flow must be kept high. Abrasives should be iron-free and grinding wheels frequently dressed.

Rubber- or resin-bonded wheels are preferable to vitrified wheels because of their minimum loading characteristics. Where it is possible to start with No. 60 grit, a fabric wheel made of 18/20 ply sections of 64/68 count unbleached muslin, with a hard center and softer periphery, may be used. For local grinding, a narrow-face wheel will be more efficient; for over-all grinding, a wider wheel is preferable.

Such a wheel may be built up by mounting sections and spacers on a spindle until the required face width is obtained. The sections are held in place on the spindle by heavy washers secured by a nut. The wheel is mounted in a lathe and the surface machined true; then it is sized with an adhesive and dried in a heated room. After abrasive is applied to the surface, the wheel may be trued with a diamond dresser or broken in on scrap stainless steel in usual way.

Another type of wheel for local grinding is surfaced with abrasive paper, or cloth, and has the advantages of retaining its shape and permitting easy exchange of abrasive to apply a fresh surface, or one with a different grit. Speeds of 5000-6000 sfpm., using a 14-in. wheel are customary.

For the first cuts on a rough weld, a rubber- or resin-bonded aluminum-oxide wheel with grit varying from about No. 16 to No. 36 may be used, depending on the size and condition of the bead. Wheels should be carefully trued to prevent hammering and have the edges rounded to avoid gouging. Lard oil may be applied to the work to retard loading and cool the work.

Grinding is preferably performed along the welding bead, not across it, as it is difficult to avoid cutting into the metal surface adjacent to the weld. Light-gage sheets should be backed up with steel plates or wooden blocks, to provide a firm base for grinding. If the weld bead must be removed and new surface matched with a polished mill finish such as No. 4, a finer-grit wheel should be used for a final operation before polishing or buffing. Where the weld deposit is particularly heavy, initial cuts may sometimes be made with cutting tools.

The temptation to force the wheel by bearing down upon it should be avoided. Allowing the wheel to ride on the work so that the cutting edge of the individual grits may do their work at recommended speeds constitutes most efficient operation.

Having in mind the characteristics of these alloys, the desirability of moving the wheel along the bead being ground without dwell will be apparent. Localized heating may cause buckling and, in extreme cases, loss of corrosion resistance. If these alloys attain a temperature of approximately 400 F., heat-tinting may result.

Where weld beads are to be ground down and finally dressed to match mill finishes on the material joined, it is desirable to finish the hard wheel grinding slightly above the finish level, so that the final treatment for matching will not result in a groove along the bead. As an aid, stops or limiting lugs may be attached to portable grinders on either side of the wheel to limit cutting to a predetermined point.

POLISHING. Forgings and hot- and cold-rolled stainless parts that have been badly scratched in handling or fabrication require coarse abrasives, followed by increasingly fine abrasives until the surface is smooth enough to permit buffing. The series would run approximately from No. 80 through Nos. 120, 150, 180 and 200. A surface polished with No. 200 cannot be successfully buffed, so an intermediate operation such as "oiling-out" is required. Stainless strip which has been properly processed may sometimes be buffed without polishing or oiling-out.

When polishing is necessary, turkish emery is quite often used after a No. 150 grit; otherwise a coarser, faster-cutting artificial emery may be used. Some polishers prefer cutting twice with the same grit, rather than going to a coarser wheel. Polishing wheels made of sewed sections and a finer count 80/90 or 84/92 unbleached muslin, with inserted cardboard spacers between sections, give good results. A new wheel may be broken in on scrap stainless steel until its surface is in good working condition.

If a standard No. 4 finish is desired, all imperfections must be removed in the grinding operations and the surface polished with No. 120 grit, using a lubricant. In some cases, where grinding is done with manually controlled equipment, a final step using No. 150 grit with lubricant may be necessary to produce a satisfactory finish. To produce the commercial No. 7 finish, preliminary grinding operations are carried further and the surface is ground with Nos. 150, 180 and 200 grits with liquid lubricants. This may be followed by No. 320 grit and a heavier lubricant such as compounds of mutton tallow and stearic acid. It is helpful to change the direction of polishing with each change of grit size to remove marks remaining from the grit previously employed.

WHEEL SPEEDS. Wheel speeds for polishing run lower than for buffing; about 6000 sfpm. is average practice. When oiling-out is required between polishing and buffing, a fairly stiff, sewed rag wheel, surfaced with turkish flour emery, is a good medium. When the wheel is dry, it is "broken down" with emery stone to take off any sharp edges, then saturated with tallow or grease. Wheel speed for oiling-out should be approximately 5,000 sfpm.

An alternate procedure has been developed commercially and is described as a greaseless method. The

ER

7

LINEAR FOOT

8	10	12

compound contains fine abrasives held together with a binder. When the binder dries, it leaves a thin layer of abrasive. Use of this process is recommended after a No. 180 wheel, at a speed of about 7,000 sfpm., to attain a soft brushed finish.

BUFFING. Buffing of stainless steel takes place in two distinct steps. A "cut buff" levels the tiny marks left from previous oiling-out operations and a "color buff" gives a mirror finish. Buffing is not generally attempted on jobs where anything coarser than No. 200 grit has been used.

In production buffing, a combination cloth and paper wheel gives good results. Alternate layers of paper and cloth are used, the cloth holding the compound and the paper keeping the buff cool. Another special type of buffing wheel is made up of muslin, folded in quarter segments of a full circle with the thread exposed to the stainless steel at a bias. No stitching is exposed to the surface being buffed, thus avoiding light marks. Color buffing employs a soft, loose and unsewed muslin or linen of 82, 94 weave. Required stiffness is built up by high surface speeds.

Buffing compounds with a wax-type binder and aluminum-oxide abrasives have given good results. For color buffing, a finer closely graded abrasive is used. Grease content of some compounds is increased if the surface is not too good and more pressure is needed to bring up the finish. Compounds containing no free grease have also given good results in shops where no high-speed buffing lathes are available.

For buffing stainless steel, surface speed of the buff should not be less than 10,000 fpm., and good finish has been obtained at speeds as high as 13,000 sfpm. Polishing lathes with spindle speeds of about 3,000-3,600 rpm., with a 14- or 16-in. buffing wheel will give satisfactory surface speeds.

Even with these high speeds, considerable pressure should be exerted on the work in order to buff economically. High pressures and speeds develop plenty of heat which, if not controlled locally, may cause slight buckling in 18-8 type stainless because of its high coefficient of expansion. It can also cause roughening of the surface and off-color work. Adequate amounts of compound on the wheel and operator experience can combine to avoid local overheating. On any standardized buffing procedure, "cut buffing" should be on the low side of recommended speed and "color buffing" on the high side for best results.

TAMPICO BRUSHING. A Tampico fiber brush, operating at relatively slow speeds of 5,000-6,000 sfpm. with a compound of fine aluminum oxide and oil mixed to a consistency of light paste will give a No. 6 commercial finish. This is a dull velvet finish, a contrast to standard mirror finish. No appreciable pressure is required. A recommended mixture is comprised of 1 part kerosene, 4 parts No. F powdered pumice, 1 part lime and 4 parts engine oil. Wheels on which lubricant has been used should be scoured with a piece of fine pumice held against the rotating wheel.

BALL BURNISHING. Burnishing of small stainless-steel parts is being accomplished by barrel tumbling with dead-soft steel balls approximately 3/16 in. in diameter. Prior to burnishing, the parts are given a preliminary roll in pumice to remove drawing and die marks. About 12 hr. of rolling will condition the parts properly. A small percentage of Vienna lime is then added with enough water to cover the load and the barrel is run at 20 rpm. for about 8 hr.

As cleanliness is important, the contents of the barrel are washed twice with a solution of sal soda and water to remove all traces of lime. Parts to be burnished may be pickled if any suggestion of scale is evident. The balls and parts are then transferred to a wood-lined burnishing barrel for another washing. White soap chips and fresh water are put in and the barrel again run at 20 rpm. for about 6 hr., bringing the parts up to a bright finish.

Barrels should not necessarily be loaded with the opening at the top. It is better practice to lower the opening and ease the work and burnishing material into the barrel. Parts should be completely enveloped by the burnishing mass.

ELECTROLYTIC POLISHING. Electropolishing of stainless steels provides a rapid means of finishing intricate shapes in production quantities. Formed wire products, resistance-welded wire products, parts too small to hold against wheels and deeply recessed parts are particularly adapted to this method of polishing.

In anodic treatment, the work is the anode and metal is removed, the amount depending upon time of immersion, condition of the surface and current density. Immersion for 5 to 10 min. normally removes about 0.0005 to 0.001 in. and 10 to 20 min. will remove as much as 0.002 in. Slight metal removal is most desirable in conventional practice.

One commercial patented solution is made up of 55 to 60% industrial-quality citric acid, 15% sulphuric acid, and the balance water. The solution is maintained at about 200 F. Normal immersion time is from 5 to 10 min., increasing to 15 min. for rougher surfaces. Current density is about ½ to 1 amp. per sq. in. of surface. Flexibility may be obtained by varying immersion time and current density.

Individual racking of parts is necessary with this solution, the racks generally being made of acid-resistant copper alloy with a protective coating at all but contact points. Processing tanks are usually lined with lead, and one or two hot-water rinsing tanks complete the setup.

Solution temperatures are maintained by immersion-type heaters. Should overheating occur, cooling is provided by air agitation or coils. Air agitation while the current is off may cause the solution to attack the copper cathode.

Another solution, particularly recommended for chromium-nickel, consists of 765 cc. of acetic anhydride, 185 cc. of perchloric acid and 50 cc. of water. The anhydride is poured into cooled perchloric acid, the water added and the solution allowed to stand 24 hr. before being used.

The solution is maintained below 100 F., with a current density of ¾ to 1 amp. per sq. in. and about 60 volts. Rinsing in water and alcohol removes any residue from electrolysis on the part.

BLACKENING. Increasing numbers of applications are calling for the black-coating of stainless steels. Black-coating is done in a non-aqueous bath at moderately high temperatures and forms an oxide of the metal, not a hydroxide. All grease, scale, oil and other impurities are removed before blackening.

A molten solution of sodium dichromate is raised to approximately 750 F. and the part immersed in a tank. Stabilization usually takes place in about half an hour. When parts are at room temperature, they may be rinsed in hot water and air-dried. The application of a black coating slightly increases both the heat and corrosion resistance of stainless-steel parts.

ROUND TABLE

Small-Shop Pool?

"THE BOYS across the street at the pump works are getting big ideas, Al. They're teaming up with two other small shops to take jobs. It looks to me just like a way to spread any profit—and any headaches—over more ground."

"I don't know about that, Ed. Actually, we're doing the same thing, but under one management. Some of the special and expensive machines are in each shop department, and you have some here in the toolroom. We route jobs back and forth to the right machine—which is probably what those boys have in mind too."

"But, Al, all of our equipment is owned by one company. It's just spotted in different departments. If you send me in a job for the big lathe and I wreck the piece, the same owner pays the bill. What if the pump works sends one of the other guys a job and he louses it up?"

"I suppose the fellow that ruins the job pays most of the cost, if he can be proved at fault. Those three won't have any more trouble proving who made a mistake than we do—if they have as much."

"Well, if they're so willing to cooperate, why don't they just join up all the way—throw in together everything they've got?"

"Lots of reasons, Ed. They can maintain their own individuality—can even compete with each other. What's more, each plant can hold its own name and any reputation it has as a specialist in one line. The pump works, for example, is pretty good at boring jobs and may want people to remember that."

"Why don't they stay completely separate, then? Why get tied up with a couple of other outfits and take on additional trouble?"

"It's a smart stunt, Ed, whenever a job comes along too big for any one of them to handle alone. What's more, they can pool their equipment—in idea, if not in fact—so the pump works provides boring mills, somebody else a big planer, another guy a long lathe, and so on. It cuts down each shop's investment—like borrowing a neighbor's two-man saw when a tree blows down."

"Yeah, Al, and sending it back with a couple of teeth knocked out. Nuts to that! I want to have a job under my thumb all the time—then I know that each operation will be done to suit the next one."

"Look, Ed, don't be old-fashioned. The little fellows can take the crumbs we leave, if they want to go it alone, but to handle anything big, they've got to gang up. Seems to me I heard a case in Denver where three outfits went together. Each concern designed its own mining machinery and bid for business as usual. But, regardless of who got the order, it was built on a cooperative basis. Worked out pretty well, too, from what I hear."

"It still sounds strictly screwy to me, Al, and none of your talking can change my opinion."

WHO IS RIGHT, *Ed or Al? How important is complete independence in comparison with ability to take on any job? Are men who start small shops (usually strong individualists) able to work together? What are your opinions or experience? Other readers will be interested and discussions published will be paid for. Discussions of earlier topics will be found in later pages of this issue.*

Don't Keep Foremen in the Dark on Costs

BY PHILIP BERNSTEIN, WINCHESTER REPEATING ARMS COMPANY

Shop men will help cut delays and improve processing methods if they know what costs should be. Mr. Bernstein suggests a plan based on standard hours

THE AVERAGE factory department receives a monthly statement of its expenses, with the various accounts expressed as a percentage of direct labor. But a foreman cannot tell from one month to another how much work is represented by $100 of direct-labor expense. In the previous month, there might have been changes in processing time that seriously affect the value received for each $100 of direct labor.

If a department processes only one product, for example, a 30-cal. shell, the simplest and most accurate method of submitting cost information to the department foreman is the cost per M (per thousand) units. This cost should be broken down into direct labor, indirect labor, excess labor and overtime, plus tool costs if they can be compiled quickly enough for each payroll period.

Suppose that for the week ending 5/12/45, the expense burden is expressed as a percentage of direct labor:

Direct Labor.....$1000
Other Labor..... 800 80%

If during the same period, a change in processing reduced the direct labor per unit by 20%, the statement would read:

Direct Labor.....$800
Other Labor..... 800 100%

From the latter statement, it appears that the department's labor burden has gone up from 80% to 100%. However, the foreman knows that he has made a definite saving, because he is producing as many units for $1600 total labor, as he previously did for $1800. Still his burden rate has taken an unfavorable trend. By tieing in with the cost books, he can show that the total labor cost per M shells has been reduced, but this is extra work and may be delayed until the cost books are brought up to date.

When a foreman processes two or more products, it is difficult to present his costs in terms of direct labor per M units. A common denominator must be found. This denominator should be the standard hour, which is based on the time-study task, and is defined as the amount of work expected and completely processed in one man-hour of direct labor. No standard hours are credited to the department unless the work has been satisfactorily processed and not lost on the way in the form of shrinkage, spoilage and over-statement.

A firm is paid only for actual sales; it is logical that a department's costs should be based on finished products. Take the case of department DKF, which makes three products as shown in Table I. For every M units of product *A* completed, department DKF is credited with 4.25 standard hours. Likewise for product *B*, 2.11 standard hours, and for product *C*, 5.08 standard hours. For every M units of *A* completed, the department is charged with $3.60 of direct labor cost, for *B*, $1.63, and for *C*, $4.08.

Table I—Standard Hours to Make Three Products

Product	Operation	Task	Std. Hr./M Units	D.L./Std. Hr.	D.L./M Units
A	1	1000	1.00	$0.75	$0.75
A	2	500	2.00	0.80	1.60
A	3	800	1.25	1.00	1.25
		Total	4.25	Total	$3.60
B	1	900	1.11	$0.75	$0.83
B	2	1000	1.00	0.80	0.80
		Total	2.11	Total	$1.63
C	1	400	2.50	$0.75	$1.88
C	2	800	1.25	0.80	1.00
C	3	1200	0.83	1.00	0.83
C	4	2000	0.50	0.75	0.37
		Total	5.08	Total	$4.08

To carry the example further, suppose that for the week ending 5/12/45, department DKF completed 300 M of part *A*, 500 M of part *B*, and 700 M of part *C*. Assume that the payroll shows that direct labor amounted to $5230 for that week. If there had been no shrinkage, spoilage or over-statement, the direct labor would have been $4751, as follows:

$300 \times \$3.60 = \$1080$
$500 \times 1.63 = 815$
$700 \times 4.08 = 2856$
Total = $4751

We know that the difference between $5230 and $4751, or $479, must be charged either to shrinkage, spoilage or over-statement. There is one exception: when one operation is down and a backlog occurs at that operation. For this reason, do not put too much emphasis on one week's figures. The cumulative figures for a month will smooth out the effect of delays and show the correct cost trend for department DKF.

Let's look now at Table II, as submitted to the foreman for the week ending 5/12/45. He knows by simple multiplication and addition, that he has been credited with 5886 standard hours, as follows: (See Table I)

Part *A*—$4.25 \times 300 = 1275$
Part *B*—$2.11 \times 500 = 1055$
Part *C*—$5.08 \times 700 = 3556$
Total = 5886

From Table II, it can be seen that for every standard hour of work performed, the total labor cost per standard hour was $2.02. These data can be furnished weekly to each foreman, so that he can study his cost trend from week to week. When this trend is unfavorable, he must analyze process, indirect labor, shrinkage, spoilage, repairs and waiting for work.

Let's see what happens when a change in the processing time of a product is made. For example, eliminate operation 2 on part *A*. The output is the same as for week ending 5/12/45. Under these conditions, less direct labor and less indirect labor,

and consequently less overtime in dollars, are required to complete the same number of units. This is shown in Table III. The standard direct labor is now as follows, remembering that we have eliminated $1.60 per M units on part *A:*

Part A:	$2.00 × 300 =	$ 600
Part B:	1.63 × 500 =	815
Part C:	4.08 × 700 =	2856
		$4271

The number of standard hours credited to department DKF are still 5886, because the number of completed units is the same. Remember that we are only using the common denominator of standard hours instead of units of product, because of the multiple number of products. Assume that the direct labor for the week ending 5/19/45 was $4696. The various expense items are then as shown in Table III.

Payroll per standard hour has been reduced from $2.018 to $1.878, or $0.14 per standard hour, which amounts to $0.14 × 5886 = $824.04 saving in labor. Because of the processing change, standard direct labor has come down from $0.807 to $0.726 per standard hour. Excess labor has remained, at $0.247 per standard hour, because this item has not been affected by the processing change. The foreman does not have to wait for changes in the cost books. He sees clearly that he has reduced labor cost by 7%.

Tool costs per standard hour can also be included in Tables II and III if they can be tabulated by the time the payroll is ready.

The effect of substituting parts in production can be measured. Assume that the order for part *A* is completed and part *D* is substituted for it. The $1.60 per M saving in direct labor no longer applies until such time as part *A* is run again. Standard hours and direct labor costs for operations on part *D* are shown in Table IV.

For every M of parts *D* completed, 4.25 standard hours are credited, which happens to be the same number of standard hours per M of part *A*. Now $3.79/M for parts *D* is charged against the department instead of $3.60 for standard direct labor, an increase of $0.19/M, arising from the costlier type of operations on part *D*. This is no fault of the foreman, but he knows that he must put forth his best efforts to change the process on part *D*, to lower costs. In addition to this, part *A* has been reduced by $1.60/M units from the above $3.60, by the elimination of operation 2. The cost per standard hour rises, but the foreman is fully aware of the reasons.

The payroll per standard hour can now be used either for supervisory incentives or as a measuring stick for departmental performance. Using this tool, it should no longer be necessary for the foreman to ask for a raise. His record will speak for itself.

A report of payroll per standard hour, covering each department of the Cartridge Division, is now made monthly to the works manager and the division superintendent. This report covers the preceding two months and the year to date. An unfavorable change is shown in red. A portion of a report for March and April, 1945, is shown in Table V.

In addition, we are now able to advise the foreman what his labor par should be on every product. It is a simple matter to break the daily schedule down to direct labor manpower requirements and other labor manpower requirements. Each direct labor employee should produce a standard hour of work per man-hour. Delays, such as waiting for work or tools, raise havoc with costs per standard hour, the foreman and production departments must eliminate delays.

Table II—Total Labor Cost per Standard Hour

	Total	Per Std. Hr.
Std. Direct Labor	$4751	$0.807
Shrinkage	479	0.081
Indirect Labor	4280	0.728
Excess Labor	1455	0.247
Overtime (48-hr. wk.)	914	0.155
Payroll (W.E. 5/12/45)	$11,879	$2.018

Table III—Departmental Expenses With One Less Operation

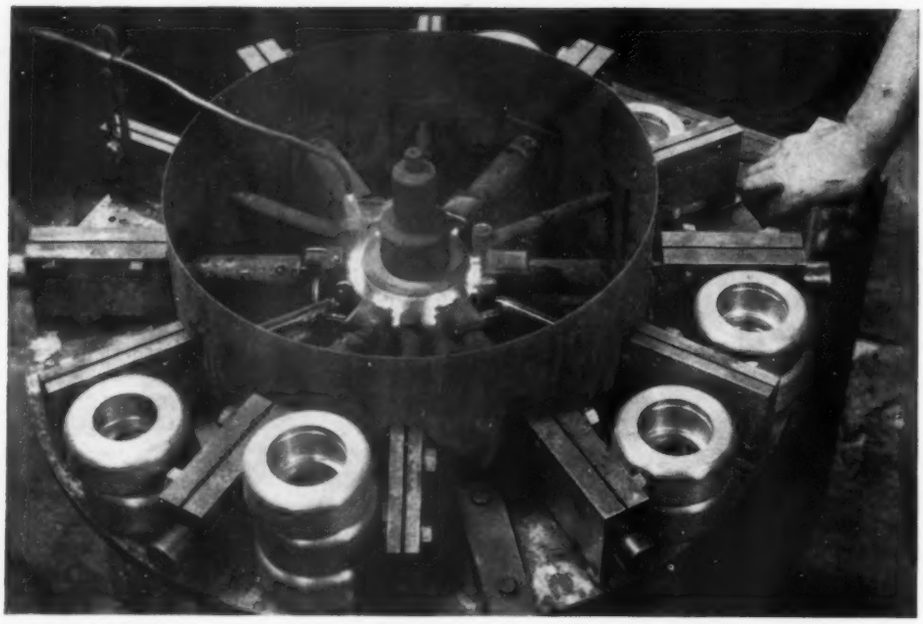
	Total	Per Std. Hr.
Std. Direct Labor	$4271	$0.726
Shrinkage	425	0.072
Indirect Labor	4050	0.688
Excess Labor	1455	0.247
Overtime (48-hr. wk.)	850	0.144
Payroll (W.E. 5-19-45)	$11,051	$1.877

Table IV—Cost of Producing Part *D*

Operation	Task	Std. Hr./M Units	D.L./Std. Hr.	D.L./M Units
1	800	1.25	$0.75	$0.94
2	1000	1.00	0.85	0.85
3	500	2.00	1.00	2.00
	Total	4.25		Total $3.79

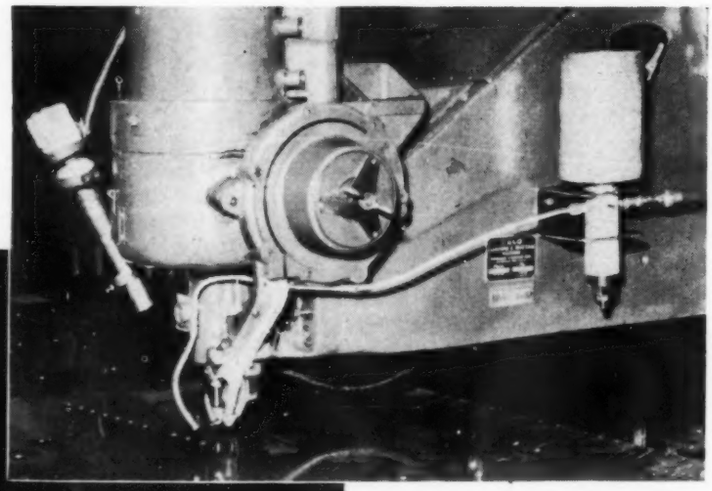
Table V—Changes in Departmental Payrolls per Standard Hour

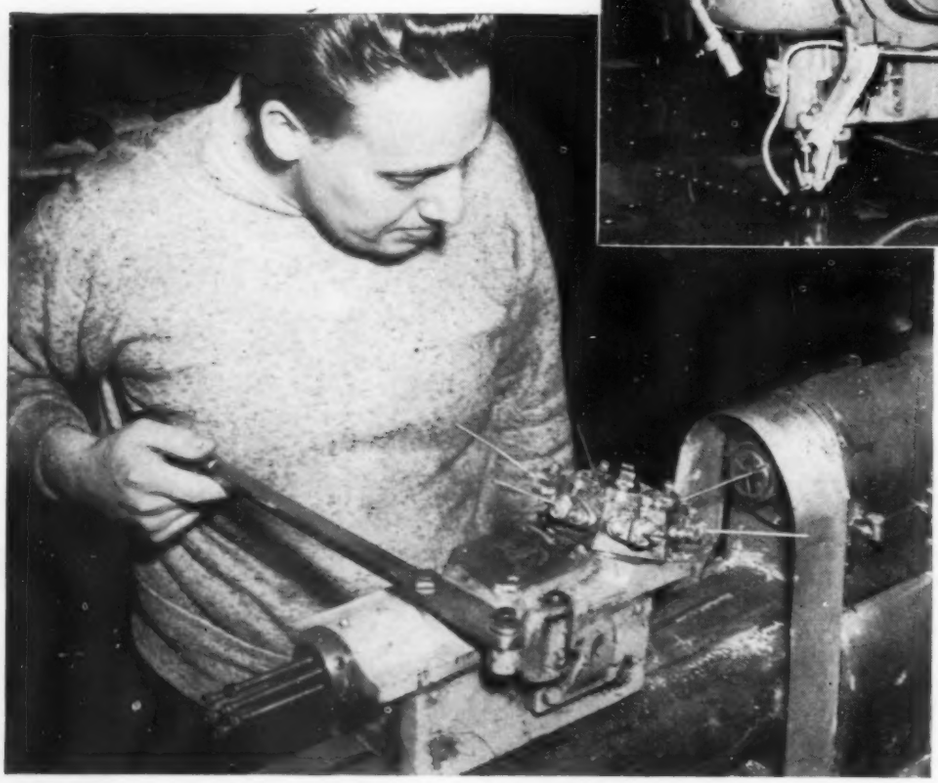
Shop	March	April	% Change	Year to Date	Best Month
DKA	1.57	1.77	+12.7	1.67	1.57
DKB	1.79	1.87	+4.5	1.82	1.67
DKC	1.82	1.78	—2.2	1.91	1.78



Small circular parts may be flame-hardened without distortion by being rotated rapidly past stationary oxyacetylene stations. After being heated to the correct hardening temperature, flames are withdrawn from the part and a spray of water directed upon them while they are still spinning. Only three of the six adjustable flame-hardening heads are used on parts under 2-in. diam. A control box and timer may be set for each hardening job for fully automatic operation. Flames and water sprays are turned on and off in correct sequence by solenoid-actuated valves. *The Linde Air Products Company.*

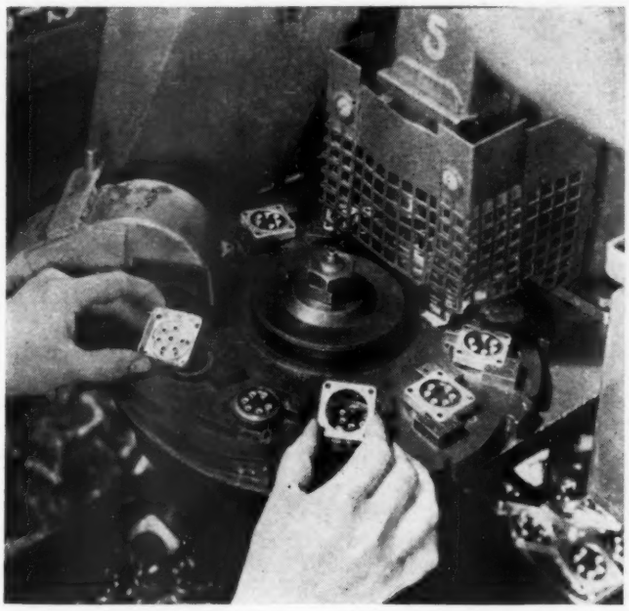
Lubrication of sheet-metal panels prior to → punching rivet holes, feeding and setting rivets by automatic equipment, previously entailed brushing oil onto the skin by hand. In this operation oil must be applied to the skins to prevent rivets from swelling between the head and skin. An automatic oil dispenser was designed to lubricate both punch and rivet with a measured charge at each stroke. *R. G. Easley, North American Aviation, Inc.*



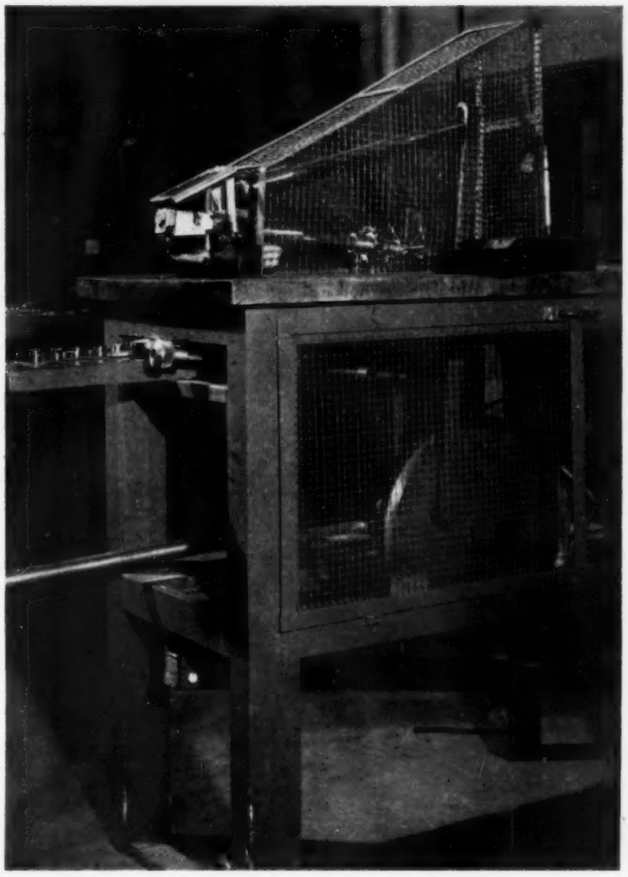


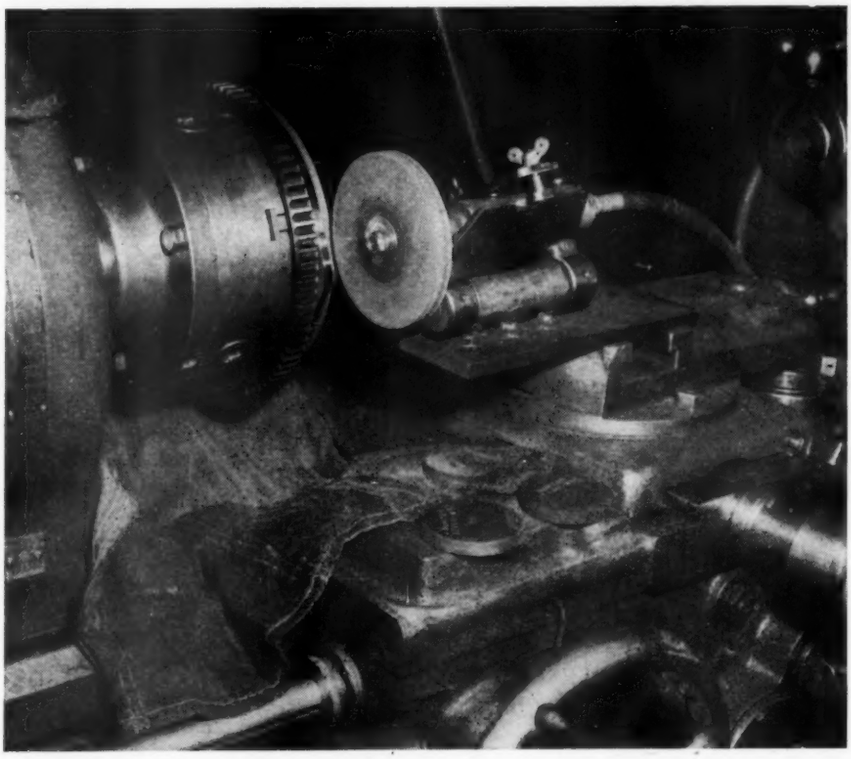
←Bores of small bearings were economically lapped by shifting the job from a dental lathe to a small precision engine lathe, equipped with a turret holding six laps. Final sizing is done by five copper laps, each 0.0001 in. larger than the preceding one. A spare lap is placed in the sixth turret position. Laps No. 1 and 2 are used with diamond dust and light oil, for rough lapping. The three remaining laps used aluminum oxide and Crisco. When a lap loses 0.0001 in. it is shifted to the preceding position in the turret and only that in the No. 1 position is discarded. *Bendix Aviation Corporation.*

SHOTS



Dial Fixtures on the base of small presses speeds up and simplifies assembly of such small parts as coil-bases and plugs. Setup is arranged so the dial, which has a dozen recesses, indexes one space for each assembly as long as the pedal is held down and recesses are being loaded. As each assembly passes under the ram, there is a dwell during which the die is closed, clinching rivets, staking or doing two or more such operations at once. For some parts an air valve is arranged to open automatically and eject the assembly into a pan when it reaches the ejector station. *Western Electric Company.*





↑ **Cable fitting** has been speeded up and one operator eliminated by application of a motor and reduction gear to drive a swaging tool. The tool was mounted on a bench and the upper operating lever was linked to a connecting-rod fitting a pin on a V-belt pulley driven through reduction belting. Oscillation of the operating lever by the connecting rod opens and closes the dies once a second. Spacing of the dies is adjusted by a knob that turns a shaft connected to the adjusting shaft by a short belt. Swaging is more uniform than that produced by a foot-operated swaging tool. *Middletown ASC, USAAF.*

← **Cams** which have become galled may be refinished by mounting an air motor on a pivoted bracket carried on a plate fastened in place of a toolholder on the cross-slide of a lathe. The air motor drives a 3-in. grinding wheel having a face as wide as the cam. Gravity feeds the wheel against the cam, which is mounted in a chuck and turns at only 13 rpm. The grinding wheel turns at 300 rpm. and follows the slowly turning cam contour. *Pensacola Naval Air Station.*

TALKING SHOP

Gnikrowlatem

ONE OF THE FEW metalworking operations in which the scrap is more important than the stock is in the making of steel wool. "Scrap" to a wool maker is the part of the bar he can't convert to wool. What's more, the tools must cut so over 80% of the wool is triangular, and must cut poorly so it is sharp-edged. The whole operation is sort of like spelling metalworking backwards.

Homogenized Alloys

ONE MAKER of homogenizing equipment has been experimenting with a method of homogenizing molten alloys. This would assure even distribution of alloying elements, avoiding blowholes and faults. It might be an answer in preventing or delaying copper precipitation or age hardening in dural.

Tough Sale

A MAN WITH A NEW PRODUCT must usually resort to a spectacular device to make his first sale. Typical was the development of porcelain-enameled tubs for washing machines. Bennett Chapple, Sr., vice-president of American Rolling Mills, tells the story. He finally got one manufacturer to try the new tub—but the maker couldn't sell 'em to dealers. Everybody was afraid of chipping. Chapple walked through the washer plant with a Brooklyn dealer, and when this objection was raised, picked up a sprocket and threw it at the nearest tub. There was a nick, but no chipping. The dealer bought ten washers with porcelain-enameled tubs to start. Now 90% of washers are so equipped.

Kaiser-Frazer is reported to be planning a washer with aluminum-alloy tub, to cost 25% less than a similar unit with steel tub. What are we offered for a sprocket?

Inefficiency Suspected

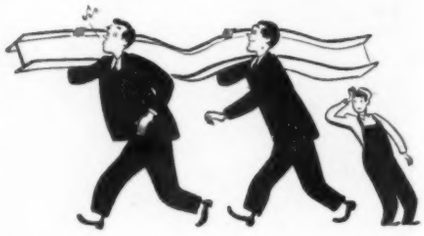
A CARTOON in a recent issue of a woodworking magazine is captioned "Until the early 1880's, it appears, British (metal) planers had their tool holders facing in one direction only, making it possible for all four cuts to be made only when the table was running forward. No work was done on the backstroke." "Won't the author be surprised when he learns that, even in 1946, the planer tools do no work on the backstroke?" asks Fred W. Cederleaf, Asst. to the Exec. Vice-President, Borg-Warner Corp.

Anti-seize Treatment

A RECENT READER QUESTION concerned a ⅞-in. tap which seizes and breaks after a few passes through stainless steel. Our suggestion was to tap through brass, applying lapping compound, and pass the tap through backwards several times. This polishes any high spots on lands, smooths the surface, and may increase clearance a trifle—anyhow, it worked for us.

Nothing to Stop You

WORKERS in other than the Plexiglas section of one aircraft manufacturer were given to rubbing their eyes when they saw two husky men laboring in unison to carry "nothing" across the floor. Several drivers of bogies tried to go between them and raised hob with a 12-ft. length of Plexiglas, thus learning that its index of refraction is about the same as that of air. Now they give the carriers a wide right of way. However, it is rumored that the boys are not above going through the motions on the return trip without the sheet—just for the trouble they can make. Something like siren-squealing fire trucks coming back from a fire, running past red lights and hogging the road—to get back to their checker game.



Beam Benders

AT THE SAME PLANT, the boys in experimental got hold of several good-sized dural I-beams. A couple were bent into outlandish shapes—and the fun began. Whenever time permitted, two of the boys would carry a straight I-beam across the plant, then shortly return with a badly bent one. Not only did it appear impossible to carry I-beams as they carried 'em, but there was no equipment where they took 'em that could bend anything as those were. Very confusing to curious people.

Glass Cars

GLASS FABRIC, impregnated with plastic and used during the war for helicopter fuselages and similar parts, is reportedly to be used for frame elements on the new Frazer, to be built by Graham-Paige. It is moldable, can be machined like steel, and does not deteriorate from exposure. Ford is supposed to be experimenting with the material for fenders. Remember that old saw: "People who live in glass houses shouldn't throw stones." Maybe this is a devious method for reducing the American enjoyment of a good collision.

. . . Who Help Themselves

DOZENS OF COMPANIES cooperated with Army and Navy hospitals by providing work and training for rehabilitating wounded soldiers. In Parma, Ohio, for example, Lamson & Sessions installed shops at Crile General Hospital. 880 convalescent service men were on the payroll, some nutting bolts, others operating nutters, pointers and other machines. They handled 769,508 lb. of products in 81,135 hr. during 11 mo. of operation.

Ford Again

FORD IS NOW chrome-plating dies to increase life and restore dimensions when not worn too badly.

Basic Relationship of HYPOID GEARS..II

BY ERNEST WILDHABER, GLEASON WORKS

PITCH SURFACES of hypoid gears have been previously shown as surfaces of revolution tangent to each other along a continuous line of contact, which can be either curved or straight. Kinematic pitch hyperboloids constitute only one very special case of these pitch surfaces which occur when the pitch lines are straight, and in turn coincide with the line of contact of the pitch surfaces.

One or both pitch surfaces of a pair of hypoid gears have a concave outline in their axial planes. The most important characteristics of these surfaces are their size and taper, which is the inclination of the common tangent plane at a mean point to the gear axes and which is directly related to lengthwise tooth curvature.

It is found practical to design and manufacture hypoid gears without reference to the curvature of the pitch surfaces in their axial planes and to work with other quantities instead. In this treatment, pitch surfaces can be replaced by their inscribed cones, which touch each other at a common mean point, and are referred to as pitch cones.

The teeth are made to extend along these pitch cones, and conical gear blanks are generally used.

Figures 8, 9 and 10 show a pair of pitch cones in various views. Fig. 3 is a view along the gear axis C''. Fig. 9 is a corresponding front view, which is a view along a line e which intersects both axes and is perpendicular thereto. Fig. 10 is a view along the pinion axis C', corresponding to Fig. 8. The gear pair referred to in these views has a shaft angle Σ, Fig. 9, which differs from a right angle, and deductions based on this will be general.

Common Tangent Plane

The common tangent plane T, Fig. 8, at mean point P, intersects the pinion axis C' at apex O' of the pitch cone of the pinion, and the gear axis C'' at apex O'' of the gear pitch cone. The tangent plane will now be referred to as the pitch plane. The pitch cones contact it along lines $O'P$ and $O''P$, which cross at P.

An important element is also the

This second installment shows why unequal pressure angles produce balanced tooth action and indicates required angles

pitch normal, the normal at P to the pitch plane and to the pitch cones. It intersects the axes C' and C'' at points K' and K''. The axes C' and C'' are offset a distance E, as in Figs. 8 and 10.

In designing a pair of hypoid gears, the tooth numbers N' and N'', offset E, and mean gear radius $R = C''P$, Fig. 8, are usually given. The radius of the pinion $R_p = C'P$ in Fig. 10 would be $\frac{N'}{N''} \cdot R$ in bevel gearing. In hypoid gearing an enlargement factor k goes with it:

$$(7) \quad R_p = \frac{N'}{N''} \cdot R \cdot k$$

For usual design a factor $k = 1.3$ to 1.5 is adopted and it may be increased for large ratios. This factor controls the spiral angles of the teeth.

The position of point K'' may be assumed, as will be further pointed out, that is its distance $Q = K''O$, Fig. 9, from the crossing point O of the axes. This distance is the chief taper factor, and controls the lengthwise curvature of the teeth.

Angle $\eta = C'K''O''$, Fig. 10, can now be determined

$$(8) \quad \tan\eta = \frac{E}{Q \cdot \sin\Sigma}$$

$\frac{C''K'}{R}$, Fig. 8, is equal to

$$\frac{Q \cdot \sin\Sigma}{Q \cdot \sin\Sigma - R_p \cdot \cos\eta}, \text{ Fig. 10.}$$

Let ϵ denote the angle $O'K'C''$ as shown in Fig. 8. Then

$$C''K' = \frac{E}{\sin\epsilon}; \text{ hence}$$

$$\left(\frac{E}{\sin\epsilon}\right) = \frac{R}{1 - \frac{R_p \cdot \cos\eta}{Q \cdot \sin\Sigma}}$$

$$(9) \quad \left(\frac{\sin\epsilon}{E}\right) = \frac{1}{R} \cdot \left(1 - \frac{R_p \cdot \cos\eta}{Q \cdot \sin\Sigma}\right);$$

$\therefore \sin\epsilon, \epsilon.$

Let γ, Γ denote the pitch angles; that is, the inclination of the axis to the cone elements of a pitch surface. These angles are also the complements of the angles included between pitch normal $K'K''$ and axes C', C''.

$\tan\Gamma$ equals the elevation of point K' over point K'' lengthwise of the gear axis, Fig. 9, divided by radial distance $C''K'$ shown in Fig. 8:

$$\tan\Gamma = \frac{Q - \left(\frac{E}{\sin\epsilon}\right) \cdot \cos\epsilon \cdot \operatorname{ctn}\Sigma}{\left(\frac{E}{\sin\epsilon}\right)}$$

$$(10) \quad \tan\Gamma = \left(\frac{\sin\epsilon}{E}\right) \cdot Q - \cos\epsilon \cdot \operatorname{ctn}\Sigma$$

γ may be obtained by tipping Fig. 8 so that pitch plane T coincides with the drawing plane. The resultant inclination of the pinion axis is equal to pitch angle γ. The axis of tipping is a trace of pitch plane T in the drawing plane of Fig. 8. It can be drawn through pinion apex O' perpendicular to line $C''K'$ of Fig. 8.

Tipping Axis

The tipping axis a is shown separately in Fig. 11, which is a restricted view along the gear axis, taken in the same direction as Fig. 8. $O'H'$ is a unit distance plotted on the pinion axis C'. It appears shortened in the projection shown:

$$O'H' = \sin\Sigma$$
$$O'H_1 = \sin\Sigma \cdot \cos\epsilon$$

Point H' is located a distance $\cos\Sigma$ below the drawing plane, which contains point O'.

To tip pitch plane T into the drawing plane, rotation through an angle $(90°\text{-}\Gamma)$ is required. Point H' then moves to a position H'', and rises above the drawing plane a distance $O'H_1 \cdot \cos\Gamma - \cos\Sigma \cdot \sin\Gamma$, which is equal to $\sin\gamma$.

$$(11) \quad \sin\gamma = \sin\Sigma \cdot \cos\epsilon \cdot \cos\Gamma - \cos\Sigma \cdot \sin\Gamma.$$

After tipping, the two axes are projected into a line $O'H''$ and into a line parallel to $O'H_1$. These lines include an angle $\epsilon' = H''O'H_1$ with each other, which is equal to the angle included between the lines of contact of the pitch cones with the pitch plane. Points H' and H'' have the same position lengthwise of tipping axis a, i.e.: distance from line $O'H_1$ is the same:

$$\sin\epsilon' \cdot \cos\gamma = \sin\epsilon \cdot \sin\Sigma$$

$$(12) \quad \sin\epsilon' = \sin\epsilon \frac{\sin\Sigma}{\cos\gamma}$$

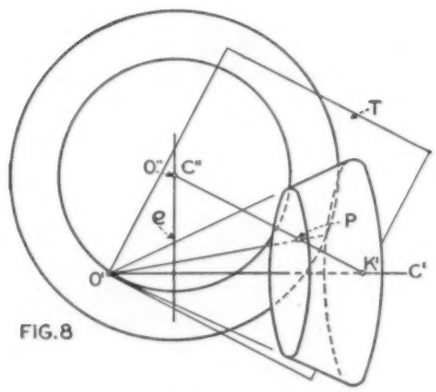


FIG. 8

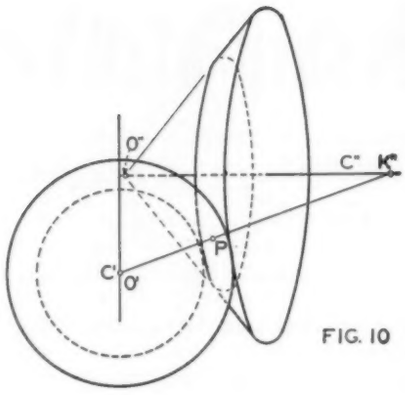


FIG. 10

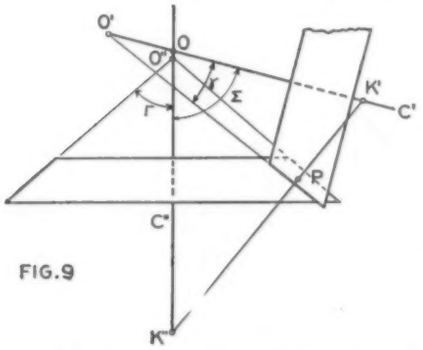


FIG. 9

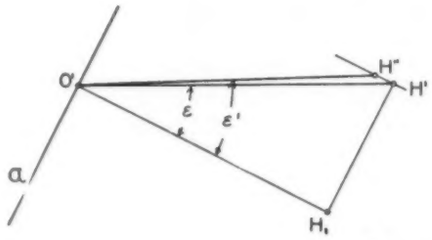


FIG. 11

Fig. 8—In this view along the gear axis the pitch cones are shown in contact with a common tangent plane *T*, which is the pitch plane. Fig. 9—An acute shaft angle is shown to keep the derivation in a general form in this front view of Fig. 8. Fig. 10—This view along the pinion axis corresponds to Fig. 8. Fig. 11—Angular relationships

Fig. 12 is a plan view of the pitch plane, showing the pitch cones contacting with it along lines $O'P$, $O''P$, which are also the projections of axes C', C''. Angle ϵ' appears here in full size, as angle $O'PO''$. Fig. 13 is a corresponding front view.

t denotes the pitch line tangent at point P, and represents the general direction of the teeth. It includes an angle ψ_p with cone element $O'P$, and an angle ψ with cone element $O''P$. These angles are called the pinion spiral angle and the gear spiral angle. Their difference, $(\psi_p - \psi)$, is equal to angle ϵ'.

Tooth contact at point P implies that the normal displacement of tangent t per tooth of turning motion is the same on the pinion and on the gear; namely

$$\frac{2\pi R_p \cdot \cos\psi_p}{N'} = \frac{2\pi R \cdot \cos\psi}{N''};\ R_p = \frac{N'}{N''} R \cdot \frac{\cos\psi}{\cos\psi_p}$$

A comparison with formula (7) determines the enlargement factor k,

$$k = \frac{\cos\psi}{\cos\psi_p}$$

$$k = \frac{\cos(\psi_p - \epsilon')}{\cos\psi_p}$$

$$= \frac{\cos\psi_p \cos\epsilon' + \sin\psi_p \sin\epsilon'}{\cos\psi_p}$$

$$= \cos\epsilon' + \tan\psi_p \sin\epsilon'$$

$$(13)\quad \tan\psi_p = \frac{k - \cos\epsilon'}{\sin\epsilon'};\ \psi = \psi_p - \epsilon'$$

Likewise

$$\tan\psi = \cos\epsilon' - \frac{1}{k}$$

$$\sin\epsilon'$$

The spiral angles ψ_p, ψ of the teeth are herewith determined.

Limit Pressure Angle

On hypoid gears the tooth action is unsymmetrical on the two opposite sides of the teeth. Equal pressure angles on the two sides generally result in unequal profile curvature. The differences may be substantial, and sometimes radical.

This is one of the points which was entirely overlooked in prior art relating to tapered gears with offset axes. With the profiles shown in the literature some of the gears could not even mesh on one side. Their mean radius of profile curvature would figure out to be zero or even negative.

The profile curvature and the tooth action can be balanced by unbalancing the pressure angles on the two sides of the teeth. One of the hypoid problems is then to determine the pressure angle unbalance required to equalize the tooth action.

On bevel gears equal pressure angles on both sides of the teeth give equal relative profile curvature, and an equal inclination of the lines of action on the two sides.

Zero pressure angle, that is zero inclination of the tooth normal, would result in zero inclination of the line of action. This must be avoided.

The limit pressure angle (ϕ_o) on hypoid gears is the pressure angle which corresponds to zero pressure angle on bevel gears and spur gears. It is a pressure angle, used for reference only, which gives zero inclination of the line of action. If a pressure angle equal to the limit pressure angle were provided at mean point P, its normal, the limit normal would continue to fulfill the requirement of contact when turned infinitesimally about axis C' or C''.

The broad condition of contact at any point of a normal can be somewhat heretically stated as follows:

The normal is in a position of contact, when a force acting along it produces turning moments on the two gears proportional to their numbers of teeth.

Or also:

The normal is in a position of contact, when an infinitesimal motion of the gear members, at the given ratio, results in equal displacements measured along said normal.

At points infinitely close to mean point P, the moment exerted by a unit force can be made up of the moment (M) exerted by the unit force when applied in the direction of the normal at the mean point, and of an infinitesimal increment moment (dM). In positions of contact the proportion $\frac{dM}{M}$ of the increment moment and the moment at P is equal on both members of the gear pair.

Fig. 14 is a diagrammatic view of the pitch plane also shown in Fig. 12. The limit normal is located in the normal plane perpendicular to tangent t, and is projected as a line PC_o. It is inclined to the pitch plane at the limit pressure angle ϕ, which is now being determined. ϕ_o is defined as positive, when point C_o of the limit normal is below the pitch plane; and negative when C_o is above.

When the limit normal is turned about the pinion axis through an infinitesimal angle, its point P moves peripherally an infinitesimal distance $v = PU$ to a position U. v is located in the pitch plane, at the infinitesimal motion considered. $\frac{v}{R_p}$ is turning angle about the pinion axis.

As the normal is turned to the new

position, it changes its direction, namely its inclination to the pitch plane, and the direction of its projection. These angular changes are as if the normal were turned through angle $\frac{v}{R_p}$ about an axis parallel to the pinion axis and passing through point P. In other words the normal may be turned about an axis which intersects it at P.

Moreover the infinitesimal turning motion about this axis can be resolved into a turning motion $\frac{v}{R_p} \cdot \cos \gamma$ about the projected axis $O'P$, and into a turning motion $\frac{v}{R_p} \cdot \sin \gamma$ about an axis perpendicular to the pitch plane and passing through P. The two component motions add up geometrically to the turning motion $\frac{v}{R_p}$ about axis C'.

An important advantage of considering infinitesimal motions is the freedom of sequence; and component motions can be considered separately, and the results then added together.

When the limit normal is turned about line $O'P$, its point C_e moves to a position C_3, shown for a positive angle ϕ. Projected distance C_eC_3 is perpendicular to $O'P$ and is:

$$C_eC_3 = PC_e \cdot \tan \phi_e \cdot \frac{v}{R_p} \cdot \cos \gamma;$$

PC_e herein denotes the projected length as in Figs. 12 and 14.

When turned about a line perpendicular to the pitch plane, point C_e moves to a position C_4.

$$C_eC_4 = PC_e \cdot \frac{v}{R_p} \cdot \sin \gamma$$

A force extending along the limit normal, and expressed by the actual distance PC_e, can be resolved into a component lying in the axial plane $O''P$ of the gear, and into a component perpendicular thereto. The amount of this latter component can be measured by the normal distance of point C_e from said axial plane, that is by the length of the dotted line shown in Fig. 14. It amounts to $PC_e \cdot \cos \psi$. It is this component only which produces any torque on the gear.

This component is reduced by $C_eC_3 \cdot \cos \epsilon'$, when the normal is turned so that point C_e moves to C_3. The torque increment of this component, in proportion to the original torque is thus

$$\left(\frac{dM}{M}\right)_1 = -\frac{C_eC_3 \cdot \cos \epsilon'}{PC_e \cdot \cos \psi} = -\frac{\tan \phi_e \cdot v \cdot \cos \gamma \cdot \cos \epsilon'}{R_p \cdot \cos \psi}$$

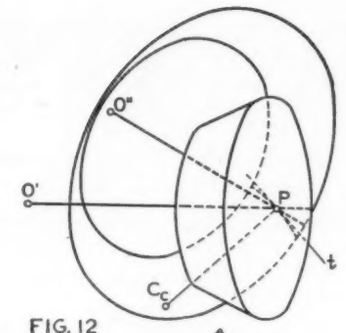


FIG. 12

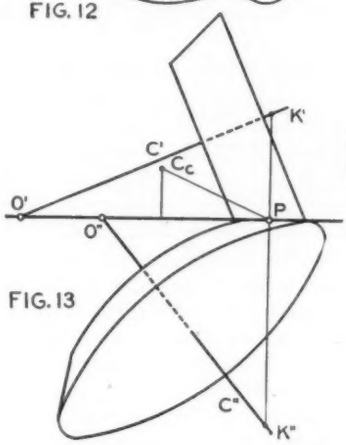


FIG. 13

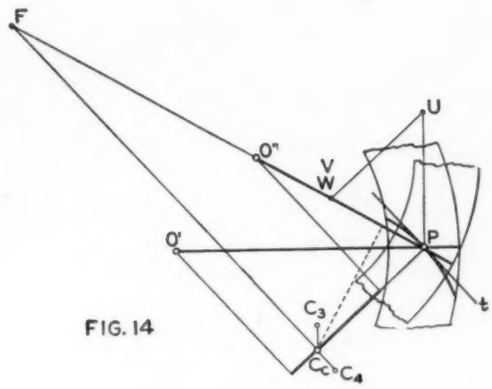


FIG. 14

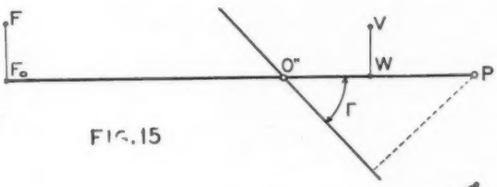


FIG. 15

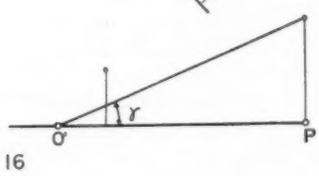


FIG. 16

Fig. 12—Pitch plane and pitch cones are in contact along lines $O'P$ and $O''P$, which includes different spiral angles with pitch line tangent t. Fig. 13—In this front view of Fig. 12 the pitch plane appears as a single straight line. Fig. 14—Diagrammatic view for derivation of required pressure angle difference and of the lengthwise curvature of the teeth which corresponds to the pitch cones shown. Fig. 15 and 16—Diagrammatic axial sections of the gear and pinion perpendicular to the pitch plane and used in derivation

The torque increment proportion $\left(\frac{dm}{M}\right)_2$ for the displacement C_eC_4 is positive and amounts to

$$\left(\frac{dM}{M}\right)_2 = \frac{C_eC_4 \cdot \sin \psi}{PC_e \cdot \cos \psi} = \frac{v \cdot \sin \gamma \cdot \sin \psi}{R_p \cdot \cos \psi}$$

What remains to be determined is the torque increment, as produced by the translation of the force from P to U, Fig. 14, while maintaining it in a position parallel to itself.

A line drawn through U parallel to the original limit normal intersects the axial gear plane $O''P$ at a point V. This point is shown in Fig. 15, which is a diagrammatic view of said axial gear plane. Its projection to the pitch plane is denoted as W. Distances PW and VW are $PW = PU \frac{\sin \psi_p}{\cos \psi} = v \frac{\sin \psi_p}{\cos \psi}$ inasmuch as angles PUW and PWU amount to ψ_p and $(90° - \psi)$ respectively.

$$VW = -UW \cdot \tan \phi_e = -v \frac{\cos \epsilon'}{\cos \psi} \cdot \tan \phi_e$$

The change in torque produced is proportional to the change in leverage, that is to the change of the normal distance from axis C'' of point V as compared with point P. The normal distance of point P is shown in dotted lines in Fig. 15, and is equal to the gear radius R. The proportional torque increment $\left(\frac{dM}{M^3}\right.$ produced by the translation is therefore

$$\left(\frac{dM}{M}\right)_3 = \frac{-PW \cdot \sin \Gamma + VW \cdot \cos \Gamma}{R} = -\frac{v}{R \cdot \cos \psi}(\sin \psi_p \sin \Gamma + \tan \phi_e \cos \epsilon' \cos \Gamma)$$

The total change of torque produced on the gear is zero for the limit normal, for there is no change of torque produced on the pinion in the considered motion about the pinion axis.

$$\left(\frac{dM}{M}\right)_1 + \left(\frac{dM}{M}\right)_2 + \left(\frac{dM}{M}\right)_3 = 0$$

(14) $$-\tan \phi_o \cos \epsilon' \left(\frac{\cos \Gamma}{R} + \frac{\cos \gamma}{R_p}\right) = \frac{\sin \Gamma \sin \psi_p}{R} - \frac{\sin \gamma \sin \psi}{R_p}$$

With $\frac{R}{\sin \Gamma} = A$, $\frac{R}{\cos \Gamma} = A \tan \Gamma$, see Fig. 15, $\frac{R_p}{\sin \gamma} = A_p$, $\frac{R_p}{\cos \gamma} = A_p \tan \gamma$, we obtain

$$-\tan \phi_o \cos \epsilon' \left(\frac{1}{A \tan \Gamma} + \frac{1}{A_p \tan \gamma}\right) = \frac{\sin \psi_p}{A} - \frac{\sin \psi}{A_p} = \frac{A_p \sin \psi_p - A \sin \psi}{A \cdot A_p}$$

(15) $$-\tan \phi_o = \frac{\tan \gamma \ \tan \Gamma}{\cos \epsilon'} \cdot \frac{A_p \sin \psi_p - A \sin \psi}{A \tan \Gamma + A_p \tan \gamma}$$

It can be demonstrated that the first factor, $\frac{\tan \gamma \ \tan \Gamma}{\cos \epsilon'}$, equals unity (1), on gears with right shaft angles.

Hence

(15a) $$-\tan \phi_o = \frac{A_p \sin \psi_p - A \sin \psi}{A \tan \Gamma + A_p \tan \gamma}, \quad \text{for } \Sigma = 90°.$$

Note the symmetrical structures of the formulas. The same formulas are obtained when the limit normal is moved about the gear axis C''. The limit pressure angle is a negative quantity, when the expression to the right is positive. This means point C_o of the limit normal, Figs. 12 and 14, is then above the drawing plane.

The limit pressure angle ϕ_o should be kept away from about equally on the two sides of the teeth, much in the same manner as the pressure angles of bevel gear teeth have to be kept away from zero.

This conception of limit pressure angle was originated by the author to provide a sound basis for the amount of unbalance of the pressure angles. However the limit pressure angle was found to have still more meaning. It is related to nearly all of the hypoid action, the instantaneous contact, the mesh, and profile and lengthwise curvature of teeth, as will be seen.

On the gears used in the automotive industry, and on most other hypoid gears, the pressure angle should be and is lowered on the longitudinally convex side of the teeth of the gear, and increased on the opposite side. The difference from average is approximately equal to the limit pressure angle.

With the conventional arrangement of the pinion axis below the center line of the gear, this means then that the drive side has a lower pressure angle than the coast side. A buttressed tooth is thereby obtained in a most natural manner.

$(A_p \sin \psi_p - A \sin \psi)$, appearing above is the distance of the apices O' and O'', projected to the pitch line normal. This distance is shown by a heavy line in Fig. 14.

$(A \tan \Gamma + A_p \tan \gamma)$ is the distance $K'K''$ of the pitch normal, see Fig. 13.

Lengthwise Tooth Curvature

The lengthwise curvature of the teeth will now be determined for the hypothetical case where the tooth sides have a pressure angle equal to the limit pressure angle (ϕ_o). The limit pressure angle presents a direction of the tooth normals, which averages their directions on the two sides.

The lengthwise tooth curvature at the limit pressure angle will be so determined that the pitch plane is the tangent plane to the surface of action.

In this case the surface normals at the pitch line, or pitch line tangent t, also fulfill the kinematic requirements of contact, at least those which intersect the pitch line at points infinitely close to mean point P. The normals considered intersect the limit normal at some point C_o, the curvature center to be determined.

A force acting along any of these normals can be resolved into a main force along the limit normal PC_o and into a lateral component parallel to t and passing through C_o. Thus the considered normals constitute a plane, which contains the limit normal and tangent t.

The kinematic conditions of contact are fulfilled, when the moments exerted by the lateral component force and by an equal force acting along the limit normal are in the same proportion on both members of the gear pair.

The line parallel to t and passing through C_o, along which the component force acts, intersects the plane projected as line PO'' in Fig. 14 at a point F. This axial plane of the gear is separately shown in Fig. 15. Point F has the same distance from the pitch plane as the curvature center C_o. When r'' is used to denote the projected distance PC_o in Fig. 14, said distance of point F amounts to

$$FF_o = -r'' \tan \phi_o$$

F_o, the projection of point F to the pitch plane, has a distance F_oO'' from the gear apex O'';

$$F_oO'' = \frac{r'' - (O''P) \sin \psi}{\sin \psi}$$

The normal distance of point F from gear axis C'' is therefore

$$F_oO'' \sin \Gamma - FF_o \cos \Gamma = \frac{r'' - A \sin \psi}{\sin \psi} \cdot \sin \Gamma + r'' \tan \phi_o \cdot \cos \Gamma$$

The unit force considered is inclined to the axial gear plane shown in Fig. 15 at the gear spiral angle ψ, like tangent t. It can be resolved into a component extending in the axial plane, and into a component perpendicular thereto. Only the latter component produces a turning moment on the gear. It is the product of the component force, $\sin \psi$, and its leverage, or

$(r'' - A \sin \psi) \sin \Gamma + r'' \tan \phi_o \cdot \cos \Gamma \sin \psi$.

The moment exerted on the gear by a unit force extending along the limit normal is $A \sin \Gamma \cos \phi_o \cos \psi$, and the proportion is therefore

$$\frac{(r'' - A \sin \psi) \sin \Gamma + r'' \tan \phi_o \cdot \cos \Gamma \sin \psi}{A \sin \Gamma \cos \phi_o \cos \psi}$$

The proportion for the pinion is similarly obtained, referring to Fig. 16, which is an axial section of the pinion:

$$\frac{(r'' - A_p \sin \psi_p) \sin \gamma - r'' \tan \phi_o \cdot \cos \gamma \sin \psi_p}{A_p \sin \gamma \cos \phi_o \cos \psi_p}$$

The two proportions must be equal. Hence

$$\frac{r''}{A_p \cos \psi_p} - \tan \psi_p - r'' \tan \phi_o \cdot \frac{\tan \psi_p}{A_p \tan \gamma} = \frac{r''}{A \cos \psi} - \tan \psi + r'' \tan \phi_o \cdot \frac{\tan \psi}{A \tan \Gamma}$$

(16) $$r''\left[(-\tan \phi_o \left(\frac{\tan \psi_p}{A_p \tan \gamma} + \frac{\tan \psi}{A \tan \Gamma}\right) + \frac{1}{A_p \cos \psi_p} - \frac{1}{A \cos \psi}\right] = \tan \psi_p - \tan \psi$$

r'' or $\frac{1}{r''}$ may be determined from this. r'', the projected distance PC_o, is the radius of lengthwise tooth curvature, which is coordinated to the given pitch surfaces, as will be discussed later. This curvature radius can be produced in various ways, as by a face-mill gear cutter of this radius.

A third and concluding installment on hypoid gears will go further into basic relationships and discuss generation of hypoid pairs.

Practical Ideas

HAVE YOU A PRACTICAL IDEA?... If so, send it in. Your idea will help other men, in other shops, who have a problem similar to yours. We pay for acceptable contributions prepared exclusively for this publication

CALIPERS KEPT ACCURATE BY SIMPLE LAPPING FIXTURES

R. B. TAGGART, Watson-Flagg Machine Company

Arguments and wasted material are now a thing of the past, thanks to the work of J. C. Buchanan, Arthur George and M. F. Benson who designed and built these lapping fixtures. To improve quality through the use of uniformly correct measuring instruments, the Inspection Department of the Watson-Flagg Machine Company has developed three ingenious setups of interest to anyone using micrometer calipers, vernier calipers or inside micrometers.

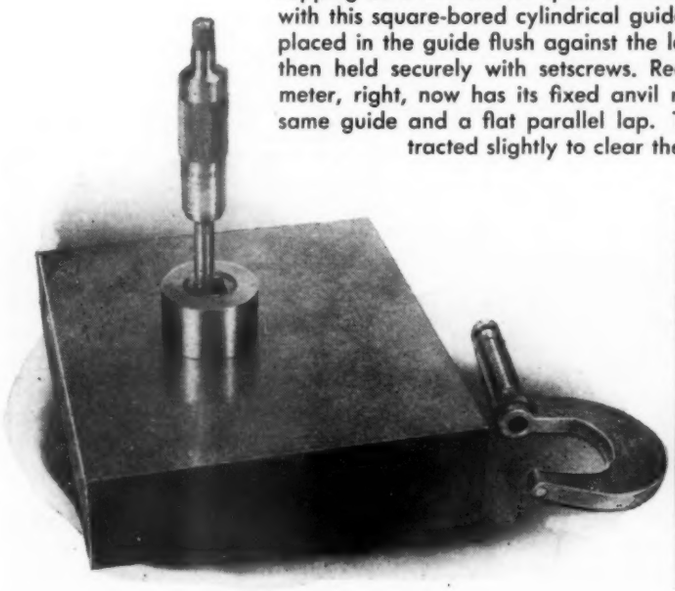
The first device is a square-bored, cylindrical lapping guide for refacing micrometer caliper anvils. The material selected is a through-hardening steel which can be heat-treated to the same hardness as the anvils themselves. The blank is rough-turned and bored and the square hole broached; setscrew holes are drilled and tapped and the outside diameter is finished in alignment with the square hole. After hardening and drawing, the two sides of the hole opposite the setscrews are lapped flat and at right angles to each other. One face and the outside diameter are ground with the piece mounted on a parallel cylindrical mandrel. Both faces are then lapped, producing a "cylindrical square."

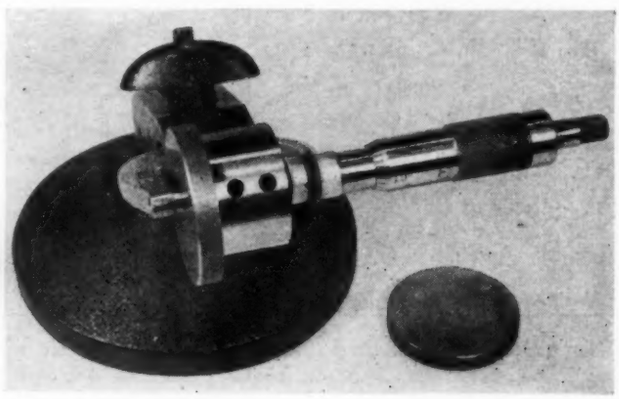
The first step in adjusting micrometer calipers is lapping the spindle anvil. The micrometer is taken apart and the spindle clamped in the guide with its anvil flush with the face of the guide. The guide assures squareness while the spindle anvil is lapped on a lapping plate. Second, the fixed anvil is lapped. The micrometer is reassembled and the guide again clamped on the spindle, this time with the anvil retracted within the square bore. A parallel flat lap trues the fixed anvil, guided by the square face of the cylindrical clamp. The third step is checking the flatness of lapping with an optical flat and monochromatic light, and then setting the micrometer with gage blocks.

A worn micrometer caliper can be reconditioned and set in less than fifteen minutes with normal skill, which means more micrometers on the job and time saved over sending them "out for repairs." The important thing is, correcting micrometers can be so simple that there is no excuse for tolerating defective ones and thus inviting shop arguments over inaccurate work.

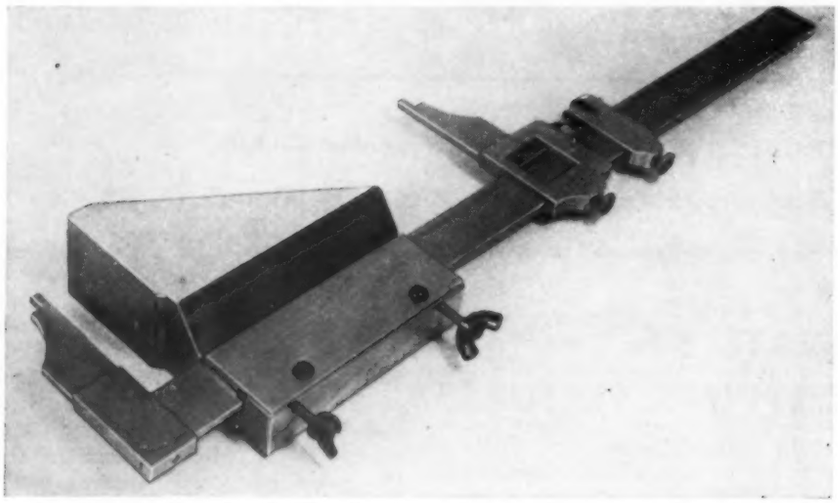
The second device is a lapping guide for correcting vernier caliper anvils. It is a right-angle block which clamps the scale of the vernier in a longitudinal groove. A clamping plate and thumbscrews hold the scale snugly in position while a lap, backed by the square guide face, trues the anvil. Slight pressure is exerted against the end of the scale to maintain contact while lapping the stationary anvil, but the vernier anvil is kept in contact with the vernier adjusting screw. After inspection for flatness the vernier plates are reset to compensate for the stock removed from the anvil faces.

The third device from the Inspec-

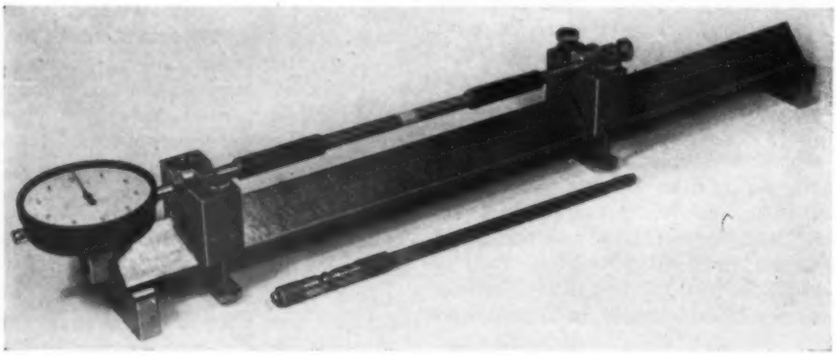




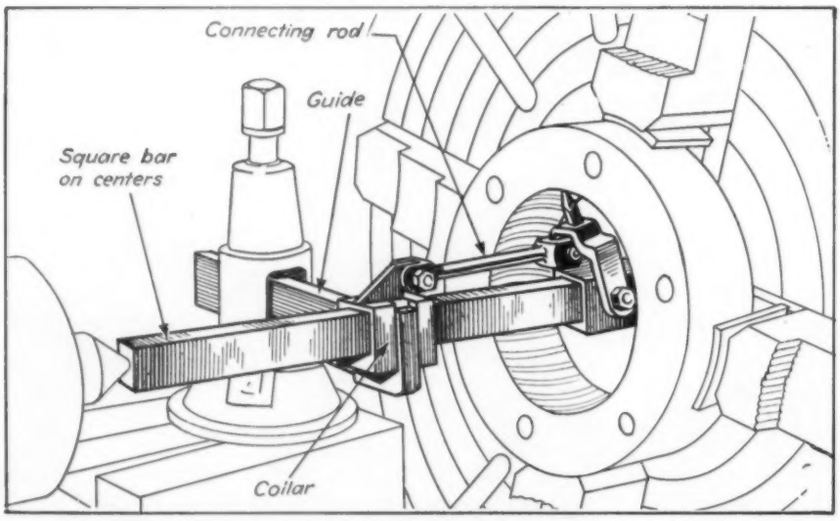
Lapping of a micrometer spindle is accomplished easily with this square-bored cylindrical guide. The spindle is placed in the guide flush against the lapping plate and then held securely with setscrews. Reassembled micrometer, right, now has its fixed anvil refaced using the same guide and a flat parallel lap. The spindle is retracted slightly to clear the lap



This vernier caliper is shown clamped in a special square to have its fixed anvil lapped. The accurate right angle is between the face and the groove which holds the graduated scale. The other anvil will be lapped in the same way



Inside micrometers are checked with this V-block comparator. After the known dimension is set with the measuring rod now in position, the micrometer (in front) will be substituted and compared



Hinged toolbit is actuated through the connecting rod by a guide bar in the compound rest. The unit is valuable for turning ball races and fillets

tion Department is a simple comparator for checking inside micrometers against carefully calibrated end-measuring rods. The micrometers and the comparing rods rest in V-blocks which slide on a V-rail base. There is a dial gage (increments 0.0001 in.) at one rail end and a positioning screw at the other, and the setup is completed with small cylindrical buttons. When the micrometer anvils are short, the gap between the anvil and the dial gage is built up with buttons, so the rod is always in perfect alignment and does not have to rest on the larger body diameter. This method eliminates the usual transfer step, using outside micrometers, and is superior to stand type comparators because of its quick alignment feature.

Lathe Tool Turns Ball Races And Spherical Bearings

GUS PABST
Naval Drydocks, Terminal Island

Concave circular arcs, both internal and external, can be turned with this adjustable-radius tool. Here, it is shown between centers in a lathe; in this position the center of the arc being turned is on the center of work-rotation so the surface produced is spherical. It can be bracketed to the lathe ways in any position with blocks and clamps with the bar parallel with the lathe spindle, at right angles to it, or at any angle. Thus, ball races for radial, thrust or combined radial and thrust bearings are within the scope of the tool. For larger work, the tool can be used on the cross slide of a vertical turret lathe or boring mill.

The toolbit is held in a hinged yoke. The yoke pivots on an adjustable sleeve on the centerline of the square bar. Another sleeve slides along the bar and acts as a crosshead. This sleeve or collar is moved by a guide, mounted in the toolpost, and transmits the motion to a connecting rod which controls the yoke. The guide is U-shaped and fits loosely on a groove in the collar. The lathe compound then, is turned so its motion will parallel the axis of the square bar, but precision alignment is not required and the bar will not be strained due to the flexibility of the coupling arrangement.

The radius of the groove is adjusted by moving the toolbit itself in or out, or by using different yokes. It should

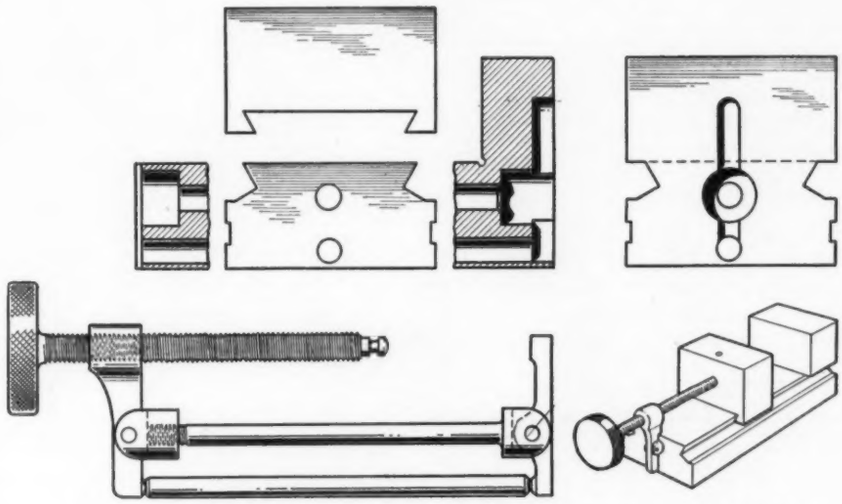
be remembered that the radius of the groove bears no direct relationship to the diameter of the work. Fillets, for example, are a common application for the tool. *Suggestion submitted under the Navy Employees' Suggestion Program.*

Precision Toolmaker's Vise Will Never Distort

ROSCOE B. BOONE

In my many years as tool and gage maker and precision inspector, I've had the opportunity to handle vises of many designs. Precision vises are carefully made with hand-lapped surfaces and accurate right angles so they can be used with surface plates, sine bars and angle plates for the highest class of work. Almost without exception, however, they invariably lose accuracy as soon as clamping pressure is applied because a bending force is bound to produce bending. This can be tested easily by using a knife-edge and prussian blue along the bottom of the vise before and after clamping the work, or simply noting whether light leaks through as pressure is applied. The inaccuracy will be small for small pieces, of course, but it is so magnified with large work that tolerances can be exceeded quickly.

With this design, the baseplate and moving jaw retain the accuracy which was so carefully built in, because they are never subjected to bending stresses. The clamping pressure in the two jaws is transmitted in a straight line through the screw at one end and to the two yokes. The center rod is under pure static tension and the lower, floating rod is in compression. The baseplate guides the rods in two holes, bored slightly oversize, and the yokes and clevises fit the counterbores in each end. The screw is fastened in the moving jaw in the conventional way. When assembling, the screw-on clevis is adjusted until the yokes are vertical.



In this vise clamping stresses are isolated in the yokes and rods leaving the base stress-free for precision gaging

Time-Saving Attachment Bores Relief Grooves in Split Bearings

F. RUSSELL ADAMS
Navy Yard, Mare Island

Along the splits of all bearings which are made in halves, relief grooves are required. Formerly, after rebabbitting, bearings were chucked in a lathe, bored with a conventional boring bar, then rechucked carefully to get the small groove in just the right position. Two rechuckings were required, one for each groove, and on some of the larger bearings (up to 18-in.) it took

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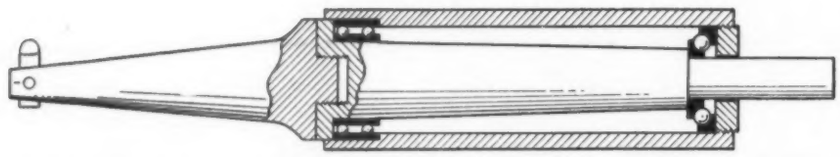
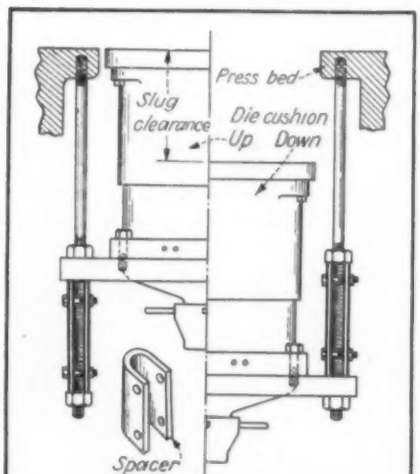


Ball-bearing lathe tool bores eccentric grooves without headstock rotation

up to three hours to handle the job.

Now, rechucking is eliminated at considerable saving in time. The work remains on center and the headstock is locked stationary with the split horizontal. A rotating tool takes the place of the boring bar and it is shifted quickly to either side to bore any radius groove with the lathe cross feed.

A threaded joint makes it possible to use long and short arbors and different sizes of toolbits. *Suggestion submitted under the Navy Employees' Suggestion Program.*



Presses requiring intermittent use of a die cushion can be made "quick-change" by extending the supporting rods and using spacers

U-Spacer and Longer Bolts For Die-Cushion Retraction

Heavy pneumatic die cushions used in general-duty presses have to be removed for some operations, and this is a slow, awkward job. With this setup, the die cushion can be jacked into position quickly and the spacers slipped in place over the supporting bolts, or it can be lowered well out of the way, but still supported and off the floor where it might be damaged.

The original supporting rods are removed and longer ones substituted. The four upper nuts control the position of the die cushion, and once adjusted, they remain fixed. The U-shaped spacer must be heavy, because four of them carry the entire load of the punch.

Two-Piece Milling Cutter Allows Axial Expansion

ROSS A. SCHULTZ
Noblet & Forrest
South Australia

Drop-forged chrome-vanadium steel open-end wrenches were milled in lots of twenty, which finished the jaws at a single pass. This was a heavy cut, so cutter breakage was high during early operations.

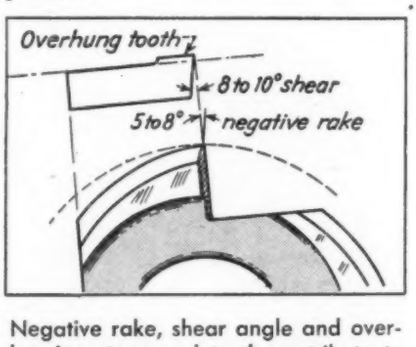
We built several four-tooth cutters, which worked successfully, and the one described here is the latest development. All were built in two pieces, split centrally at right angles to the bore. They matched to form one four-tooth cutter, but were staggered 45° apart when keyed on the arbor, making, in effect, an eight-tooth cutter. In this way, high strength, free cutting and coolness were maintained, as well as decreased shock because eight teeth replaced four. This cutter was easy to make and easy to grind, in fact, much of the grinding was by hand.

Hard spots frequently ruined conventional cutters almost instantly, whereas this cutter either withstood the shock or could be reground quickly.

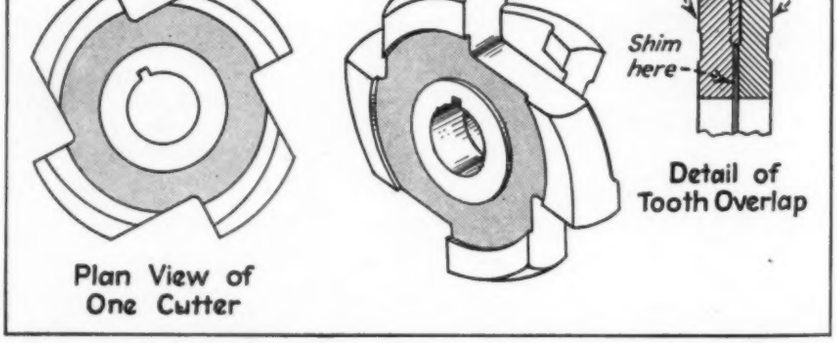
As the deep U was made at a single cut, the tool was working on three sides at once, and the faces of the cutter, having no relief, wore away rapidly. With this cutter, however, the proper dimension was restored by the simple expedient of adding shims, then grinding the faces again.

Chatter was licked by running the cutter at twice the spindle speed and three times the feed used formerly. In addition, the tooth contour probably was a contributing factor. Instead of being square across (parallel with the arbor), the faces were given 8 to 10° shear angle, and were negative raked about 7°, tending to compress the cutter and arbor on the bearings.

Overhanging teeth accomplished two things. They shared the load at the cutting point, decreasing wear at the tips of the teeth. Also, considerable expansion with shims was possible before the teeth would miss the center and leave any fin. One last detail—a relief ring was turned in the face of the cutter to localize the side wear and simplify the regrinding process.



Negative rake, shear angle and overlapping staggered teeth contribute to the cutter's free-cutting and coolness of operation



Heavy-duty milling of open-end wrenches has been improved with this hand-made expanding eight-tooth cutter

Offset-Spindle Attachment Reaches Inaccessible Holes

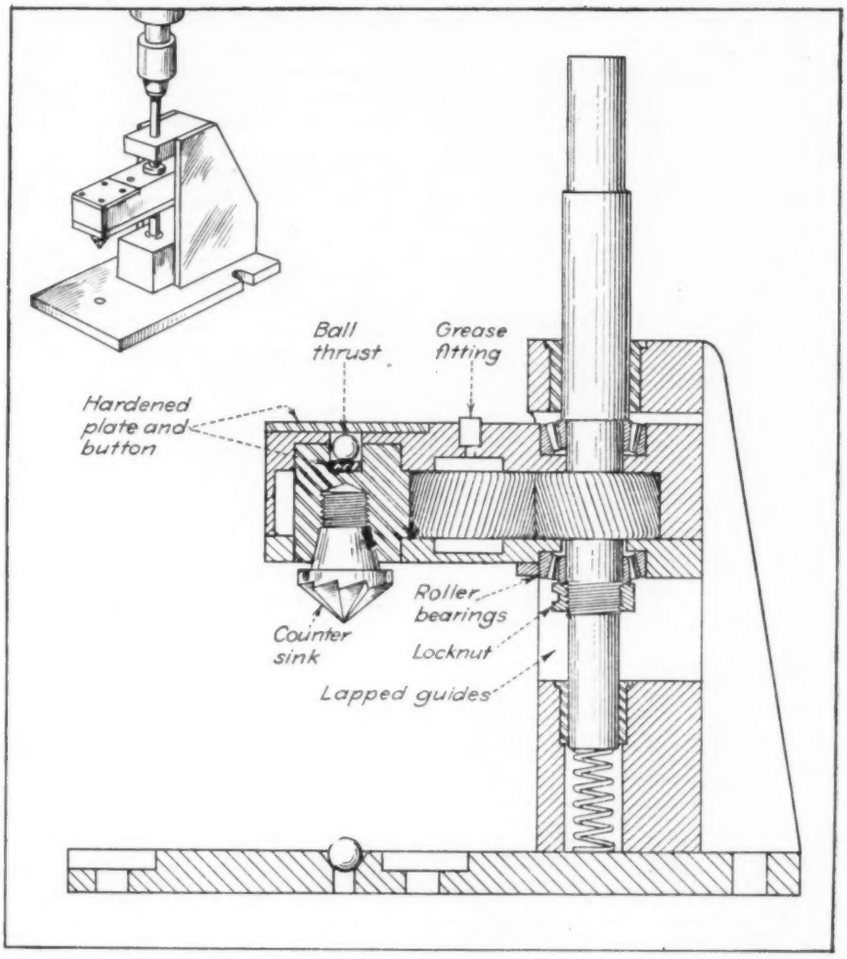
BERT G. ROBERTS
Douglas Aircraft Company, Inc.
Santa Monica

Countersinking operations of many types can be performed readily with this offsetting device when a drillpress won't reach because of the low clearance. It has been found particularly useful in finishing the holes on the inside of I-beam flanges.

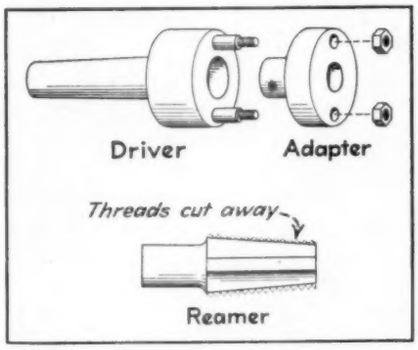
Many methods of construction are possible, and the one adopted will, of course, depend on the materials and equipment available. Here, the arm is milled from a solid block, and the heavy bending moment taken by the roller bearings on the enlarged spindle. The arm could just as well be welded up from plate, and have twin vertical rod guides to prevent both bending (vertically) and side motion. Chucking the cutter also presents a problem. The solution here was to depend on a tapered seat and threads, bored in the gear itself to save space. The tool thrust is taken with a single ball between two hardened surfaces, which can be replaced easily.

The outer gear was bought unbored, and finished as shown. Teeth were turned off the ends enough to provide narrow, but large-area bearings. The center gear can be one piece or have a pin through it. Also, it might be made of fiber to reduce noise and minimize wear on the two more important gears. The inner gear is woodruff-keyed to the spindle.

An adjustable stop can be added to the arm, but this is usually included on the drillpress itself. *Suggestions from the Board of Awards, War Production Drive.*



The low overhead clearance of this offset-arm drillpress attachment enables it to fit into many narrow openings for a variety of work



Special driver permits quick change of four tools, each equipped with the type of adapter shown. Pre-tapping reamer is ground from discarded pipe tap

Quick-Change Drivers Speed Aluminum Tapping

OSCAR CRAFT

Much time was lost in frequent tool changes when pipe-tapped holes were produced in the milling machine. Now, the work is done much faster with the aid of a driver, which is left in the spindle, plus a series of adapters.

The operation sequence is: drill, bore, taper-ream, and tap the piece. Each of the four tools is fastened in an adapter, all of which have shanks that fit the driver.

The adapters need not be fastened on the studs when reaming and tapping. Even though the exact feed is not available, the tap will find its own way into the hole.

Two more little tricks: Extra reamers for the job were quickly made from old pipe taps by grinding off the teeth. This can be done by hand with sufficient accuracy; the roots of the threads mark the proper taper. We also found that vegetable shortening makes an ideal lubricant for cutting aluminum.

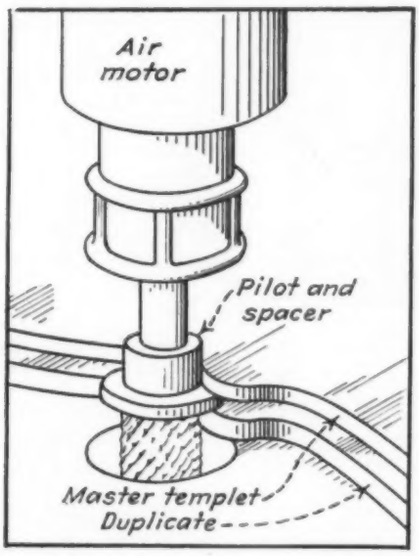
Piloted Router Makes Stack Templets

LUDWIG KOSUSNICEK
Grumman Aircraft Engineering Corp.

Drilling and routing templets are made faster and more accurately by using this router setup. Formerly, the outline was scribed and the pieces rough-cut in a bandsaw and finish-filed by hand. The filing took a lot of time because square edges had to be maintained.

One or more templets are now produced in a single operation. The master templet is fastened on top of the

stock, separated at a slight distance with washers under each screw or rivet. A flanged pilot-bushing of the same diameter as the router, and bored to fit its arbor, does two things. It guides the cutter at the correct distance from the work, because the diameter of cutter and pilot are the same, and its flange prevents accidental damage to the master.



Stack templets are made on a routing machine using a bushing on the arbor to guide the cutter. Space between the master templet and the work prevents accidental damage to the master

V-Block Drill Jig Has Eleven Stations

H. MOORE

The difficulty encountered in drilling shafts finally led me to design a special jig to simplify the job. It is a compact device, useful for one or many pieces, and has several features which, to the best of my knowledge, are original.

The jig consists of mating V-blocks aligned with four pins and including two screws for clamping. The upper plate carries a hexagon stud which positions the bushing plate. This plate has eleven equally spaced holes of the frequently used drill sizes in its periphery (more plates will provide more holes, of course) and a hex hole for the stud in the center. Now, as you can readily see, a hex hole (like a box wrench) will fit on a hex pin in only six different positions. Here, however, the axis of the hex has been offset 15° with respect to the holes so that turning it over will throw the holes 30° away. In other words, every other hole is marked for drilling with one side up and the others with the other side up. To make very sure of the accuracy, none of the holes are drilled until the hex part is completed.

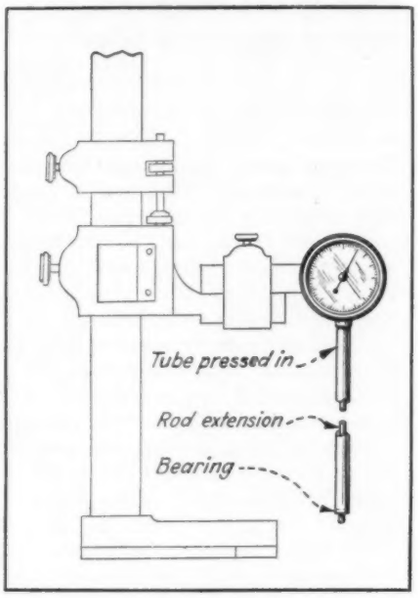
Positioning the work is accomplished in this manner: The jig plate is placed on the stud with the guide slot over the clearance hole. This slot bottoms on the circle of hole centers. A caliper work-stop (not shown) fits in the longitudinal hole below the lower V, and the distance from its arm to the bottom of the guide slot is the distance the hole will be from the end of the shaft.

Dial-Indicator Depth Gage Avoids Error Due to "Feel"

DANIEL E. McDONALD
Supervisor of Inspection,
McKiernan-Terry Corporation

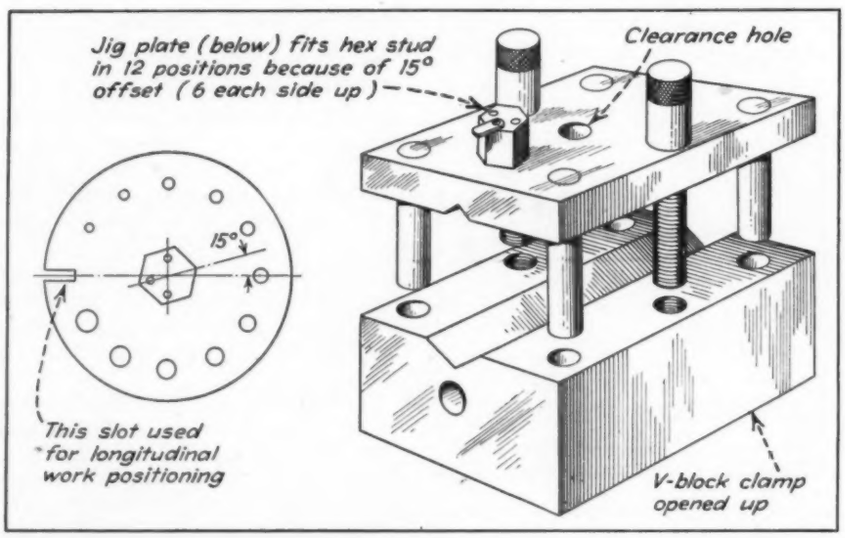
Any shop can easily make a depth-gage attachment for standard vernier height gages. A small dial indicator is provided with a piece of tubing 7 to 10 in. long, press-fitted to the stem. The other end of the tube is fitted with a brass or bronze bushing with a hole slightly larger than a long drillrod tip that replaces the regular indicator tip. The end of the new tip projects about ¼ in. from the tube and its rounded end is hardened.

This instrument is mounted on the standard straddle clamp such as is furnished with depth-gage attachments.



Small deep holes are conveniently and accurately gaged with uniform sensitivity by using a long rod extension encased in a protecting tube

Sensitivity of gaging is uniform and depends on the dial spring, not the man. A fixed dimension can be set on the vernier and variations in different parts checked with the dial gage, or the dial can be adjusted to zero and the reading taken from the vernier scale. (The dial must be set from a known dimension, or with gage blocks in any case.)


Jig plate (below) fits hex stud in 12 positions because of 15° offset (6 each side up)
Clearance hole
15°
This slot used for longitudinal work positioning
V-block clamp opened up

Double V-blocks are used to clamp round shafts while an 11-station drill plate indexes over the clearance hole for drilling

Machine Tool Electrical Standards—III

THESE STANDARDS HAVE BEEN APPROVED BY THE NATIONAL MACHINE TOOL BUILDERS ASSOCIATION

(Continued from an earlier number)

2.6.5 Operating push buttons shall be within easy reach of operator in his normal operating position, and shall be so placed that the operator does not have to reach past spindles or other moving parts which might cause injury.

2.6.6 Push-button stations are to be dust and moisture proof with metal covers and treated leather or composition diaphragm between operating buttons and switch mechanism.

Push-button stations without diaphragm are acceptable if equally dust and moisture proof.

All start buttons shall be mounted above or to the left of their associated stop buttons.

All push buttons should be mounted so that the button movement is in a horizontal plane and readily accessible.

Emergency stop push buttons shall be of the palm or mushroom type unless otherwise specified.

2. CONTROL

2.6.7 All front-of-board mounted starters, contactors and other control devices shall be mounted on a rigid panel in such a manner that the complete control panel can be removed through compartment opening. Each device in turn shall be mounted with machine screws with American National form of thread so any unit can be replaced without removing the panel.

2.7—Panel Wiring

2.7.1 All panel wiring shall be done in a neat and workmanlike manner.

2.7.2 Panel wires shall be of suitable size and shall be supported mechanically where necessary to keep them in place. Wherever possible they should not be over one layer deep, when run parallel.

2.7.3. All terminals for external connections shall be plainly marked to correspond with the marking on the wiring diagram.

2.7.4. Multiple device control panels shall be equipped with terminal boards for all outgoing control wires.

2.7.5 All control devices shall be front connected except such direct current and large alternating current equipment as is not commercially available for front connection. For back-connected equipment, back compartment doors or swing-out panels shall be furnished.

2.8—Type of Control

2.8.1 Unless the purchaser specifies otherwise, or unless the machine requires limited accelerating torque, full-voltage starting shall be employed for a.c. motors.

2.8.2 All disconnect switches and ac. motor starters shall open all of the power conductors leading to associated motors.

2.8.3 All polyphase control apparatus shall be in accordance with American Standard for Industrial Control C-19-1943 for 600-volt service, regardless of voltage applied (but see 2.1.2). This does not apply to indicating of work lights or special apparatus referred to in paragraph 4.5.3.

2.8.4 All control contacts operated by slow moving mechanisms shall be of the quick make and break type when used on under voltage release (two wire) circuits. This does not apply to push buttons or selector switches.

2.8.5 There shall be terminals on or adjacent to all solenoid and control coils. All coils shall be marked with voltage, frequency, coil numbers, and manufacturer's name or trademark.

2.8.6 Where machine operation requires a magnetic starter repeatedly to open stalled motor current such as plug-stop or such as jogging (inching) duty requiring continuous operation at a rate in excess of 5 per min., the starters used shall be in accord with the accompanying table:

HORSEPOWER RATING

Size Numbers	220V Three Phase		440-550V Three Phase	
*00	½ maximum		½ maximum	
* 0	1	"	1	"
1	3	"	5	"
2	10	"	15	"
3	20	"	30	"
4	30	"	60	"
5	75	"	150	"
6	150	"	300	"

***See 2.1.2 "Automotive Standard"**

3. MOTORS

3.1—Standards

3.1.1 Motors shall conform to requirements of the American Standards for Rotating Electrical Machinery, C50-1943, and American Standard Terminal Markings for Electrical Apparatus C6.1-1944, and to the NEMA Motor and Generator Standards, 45-102 (June 1945 edition) or the latest revisions thereof (but see 3.2.3).

3.2—Type of Motors

3.2.1 The type of motor inclosure to be used, such as open, totally inclosed, totally inclosed fan cooled, or drip-proof, depends upon the condition of the individual application. Purchaser shall specify type of inclosure desired, otherwise machine tool builder shall determine what is to be furnished. Before quoting, vendor must ascertain purchasers available power supply data. All integral horsepower ac. motors frame 445 or smaller but not to exceed 75 hp. are to be 220/440 volt type excepting multi-speed motors, unless other voltage is specified. Where polyphase power is available, ac. motors ¼ hp. and larger should be polyphase.

3.2.2 . . . *Automatic Standard* (instead of 3.2.1

All a.c. motors up to and including 1½ hp.; 1800 rpm, are to be totally inclosed, anti-friction bearing, with fan cooling optional. Motors over 1½ hp. are to be totally inclosed, anti-friction bearing, fan cooled. Where polyphase power is available, motors ¼ hp., and larger should be polyphase. Any deviation from the specifications must be approved in writing.

Before quoting, vendor must ascertain correct electrical characteristics. All integral horsepower ac. motors, frame 445 or smaller but not to exceed 75 hp., except multi-speed motors, shall be for 220/440 volt, unless other voltage is specified.

3.2.3 . . . Automotive Standard (in addition to 3.2.2) The use of the following must have purchaser's approval in writing:

Ring-mounted motors either vertical or horizontal
Motors with machined end plates
Shaftless motors
Gear-head motors
Double-shaft motors
Special-length shaft motors
Any motor not a complete NEMA frame of 1940
Motors other than original NEMA frames and horsepower ratings of 1940
All other than anti-friction bearing motors
Other than separate-base mounted brakes
Multi-speed motors
Short-time rated motors

3.3—Mounting of Motors

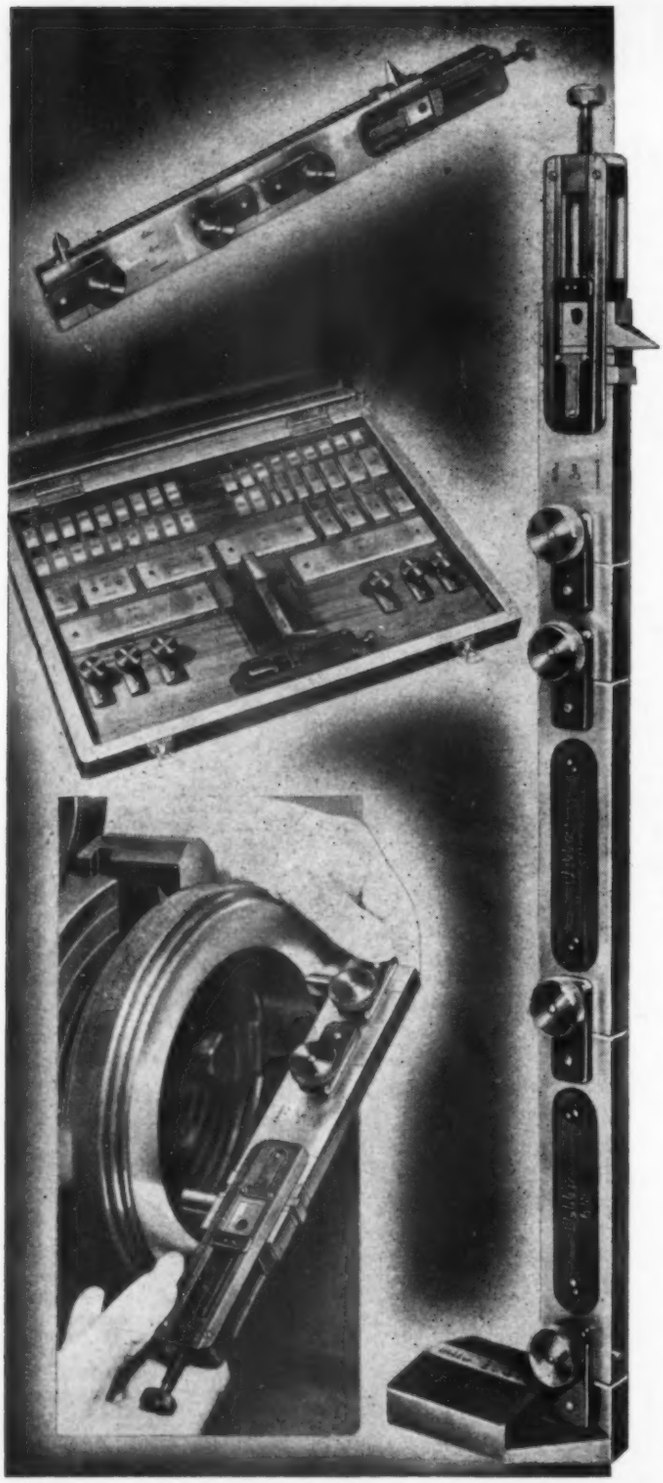
3.3.1 Motors shall be mounted where they are accessible for maintenance and are protected from damage.

3.3.2 The motor mounting arrangement must be such that all motor hold-down bolts can be easily removed and replaced and conduit boxes easily reached. Both motor and bearings on sleeve bearing motors must be arranged for checking lubricant levels, and belts must be easily replaceable.

3.3.3 . . . *Automotive Standard* (instead of 3.3.2)

When motors are mounted inside of a machine, the motor compartment must be of sufficient size to accommodate a 60-cycle motor with terminal inclosure (original NEMA) one frame size larger than the maximum frame size recommended by the machine tool builder for driving the machine. The motor compartment must also be of such size that all motor hold-down bolts can be easily removed and replaced and terminal enclosure easily reached.

CONTROLS PRECISION PLANT-WIDE



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In a few seconds you can assemble a positive, accurate inside or outside caliper—a precision divider—an absolutely dependable height gage and many other precision tools.

The patented Eccentric clamps and quick acting clamp enable you to make up these precision tools quicker than by any method devised to date.

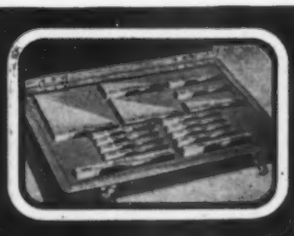
Dependable accuracy is assured as no holes are required through measuring surfaces. Speed of assembly is acquired by ease of clamping blocks together—no rods, nuts or screws to fit and try. You merely select the blocks necessary to make desired dimension, clamp them together with the patented Webber clamps and your precision tool is ready for use instantly.

The same inherent quality that has gained such wide acceptance for Webber standard gage blocks is also found in Webber Heavy Duty Gage Blocks.

For speed—accuracy—and ultimate economy use Webber Heavy Duty Gage Blocks.

Prices

Set No. 84-A $350.00	Set No. 43-A $185.00
Set No. 84-B $235.00	Set No. 43-B $150.00
Set No. 38-A (Thin Blocks) $195.00	
Set No. 38-B (Thin Blocks) $155.00	
Set No. 24-HD (Heavy Duty) . . . $385.00	
Capacity up to 36 inches	
Set No. 36-HD (Heavy Duty) . . . $450.00	
Capacity up to 36 inches	



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Machine Tool Electrical Standards—IV

Both motor end bearings on sleeve bearing motors must be arranged for checking lubricant levels, and belts must be easily replaceable. Unless the motor compartment follows these specifications, the motor must be mounted on the outside of the machine and space provided for a motor one frame size larger than the maximum horsepower recommended by the machine tool builder.

3.3.4 Motor compartments must be clean and dry and adequately vented direct to the exterior of the machine and all openings must be of such height above the floor and be protected to such an extent that dirt and chips cannot enter at such times as the floor is swept or washed or the machine is cleaned. Unless other compartments meet the requirements of the motor compartment, there shall be no openings of any kind between the motor compartment and any other compartment of the machine. If a conduit or pipe is run into the motor compartment from another compartment not meeting motor compartment requirements, any clearance around the conduit or pipe must be sealed.

3.3.5 All direct-connected foot-mounted motors must be properly aligned and doweled in place. Flange-mounted motors need not be doweled if otherwise positively held in alignment.

3.4—Balance

3.4.1 Static and dynamic balance and noise control shall be limited to elimination of machine trouble from these sources. Specially balanced motors must be so indicated on a nameplate.

4. WIRING

3.5—Motor Nameplates

3.5.1 Whenever the motor nameplate is not visible, a plate with duplicate information shall be provided where it can be readily seen. Nameplate shall not be removed from motor.

4.1—Wiring Methods

4.1.1 Wiring on electronic control panels is not covered by the following standards except as specifically stated.

4.1.2 Wiring methods here set forth shall be used for voltages not exceeding 600 volts.

Recommended Practice: It is recommended that all motor and control circuits on machine tools be given a high-potential test after all wiring has been completed, in accordance with American Standard for Industrial Control C-19-1943 and American Standard for Rotating Electrical Machinery C50-1943.

4.1.3 Current-carrying capacities of conductors external to control panels as shown in the National Electrical Code, as revised from time to time and approved by the American Standards Association, shall not be exceeded.

4.1.4 . . . *Automotive Standard* (in addition to 4.1.2)

Power wiring external to the control panel shall be large enough for the next larger horsepower size motor.

4.1.5 All splices in power wiring shall be covered with varnished cambric or oil-resisting synthetic tape equal to wire insulation specifications, or approved friction tape, plus coating of oil-resisting varnish.

4.1.6 Underwriters' Laboratories approved solderless connections shall be used instead of soldered type lugs.

4.1.7 All sharp edges, burrs, rough surfaces, or threads shall be removed from conduit fittings, conduit, raceways, or any other part with which the insulation of the wire comes into direct contact.

4.1.8 Control wires must run continuously from one piece of apparatus to another without any splice in conduit or junction boxes. Multiple connections shall be made on terminal boards which shall be suitably inclosed.

4.2—Type of Conductors

4.2.1 All wiring shall have 600-volt insulation of Underwriters' approved varnished cambric or of synthetic compound, except under the following conditions:

(a) Where subject to oil, coolant, moisture, or vapor, the use of synthetic compound insulation is required.

(b) Where required by ambient conditions, other insulating materials may be used. Special insulation shall be used for conductors flexed at temperatures below —10 C.

(c) Synthetic compound insulation shall be not less than 3/64 in. thick, except that 2/64 in. thickness may be used for:

(1) 110-volt circuits,

(2) Power circuits 600 volts or less in non-metallic multi-conductor, flexible cables.

4.2.2. . . . *Automotive Standard* (instead of 4.2.1 c

Insulation shall not be less than 3/64 in. thick, except where it is necessary to use non-metallic multi-conductor flexible cable.

Recommended Practice: Insulation 3/64 in. thick should be used on 110-volt circuits.

4.2.3 For purposes of these standards, "synthetic compound insulation" is defined as oil-resisting, slow-burning synthetic material such as polyvinyl compound covered by ASTM Standards No. D734-43T, with a maximum operating temperature rating in air of at least 80 C. for a single conductor.

4.2.4 All conductors subject to frequent movement shall have extra-flexible stranding, with allowance of sufficient slack to avoid sharp flexing and strain.

4.2.5 All wiring external to the control panel shall be stranded.

4.2.6 Circuit and control conductors on or in machines shall not be smaller than No. 14 A.W.G., except as follows:

(a) Copper conductors in flexible, non-metallic, multi-conductor control cable to continuously moving parts may be No. 16 if all such conductors are insulated for the maximum voltage of any conductor in the cable.

(b) Copper conductors to electronic and precision devices, not smaller than No. 18 if in conduit, or than No. 20 if not in conduit, may be used.

4.3—Control Wiring

4.3.1 The designation "control circuits" means the circuits used for the operating control of the machine, as distinguished from the circuits used for power such as circuits to motors, solenoid brakes and solenoid valves, except that the circuits to solenoid brakes, solenoid valves or similar solenoid operated equipment which take 20 amp. or less with solenoid blocked in the open position and at normal voltage, may be considered control circuits.

4.3.2 The control circuit shall be taken from a source on the load side of the main disconnect switch, excepting when the purchaser approves the provision of a separate control circuit disconnect switch, in which case the control circuit may be taken from the line side.

4.4—Identification of Wires

4.4.1 Wires other than control-panel wires shall be identified by marking with a number to correspond with the diagram. If a conductor color-coding scheme is used it should be used throughout the machine and between devices on the control panel in accordance with the following table, with a legend on the wiring diagram explaining the scheme. Exception: Deviation from this scheme may be made in flexible multiconductor cable, and also on internal wiring on individual devices purchased completely wired.

The recommended color coding scheme is as follows:

(a) Line and load circuits a.c. or d.c. power—black or gray
(b) AC control circuits as line voltage—red
(c) AC control circuits at lower than line voltage—orange
(d) DC control circuits—blue

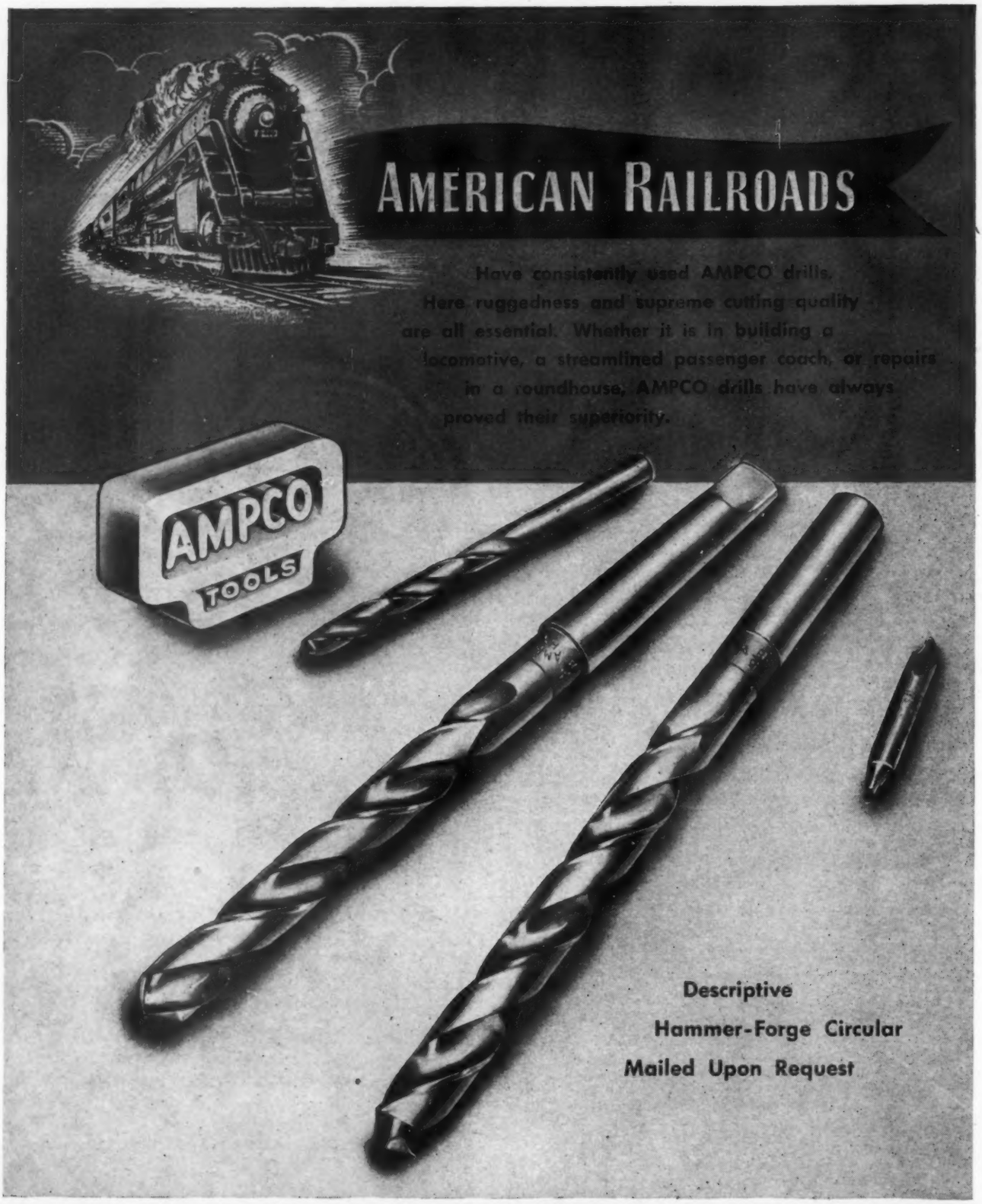
4.4.2 When a machine is so constructed that wiring must be disconnected for shipment, terminals and wires shall be marked. Markings shall be in accordance with American Standard Terminal Markings for Electrical Apparatus C6.1-1944, or the latest revision thereof. When the construction of a machine necessitates shipment or moving in sections, a marked terminal board in a suitable inclosure shall be provided at the sectional points.

4.4.3 Wiring shall be so arranged that circuits may be checked at accessible locations, preferably at the control panel.

4.5—Reduced-Voltage Control Circuits

4.5.1 Where a.c. low-voltage control circuits are requested by the purchaser or considered necessary by the builder, the control voltage shall be 110 volts obtained from a transformer with an isolated secondary winding, and the control circuit shall be protected by fuses or equivalent overcurrent protective devices placed in the transformer secondary circuit. (Approximately 95-volt, 50-cycle control circuits may be used where 60-cycle coils are used for both 50- and 60-cycle devices.)

(To be continued)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SPOT NEWS

Beech Aircraft is reported developing automobile with air-cooled 90-hp. aircraft engine that will drive electric generator which in turn will actuate small electric motors on each individually-sprung wheel. Car is of light aircraft-type construction, accommodates six people, probably will sell around $5000.

Farm implement makers will concentrate on repair parts production when operations are resumed. This is because strikes and shortages have forced them to miss the spring season. Farmers will buy one billion dollars worth of implements this year if they can get them. Output this year will be same as '45, with heavy backlog for 1947.

Soviet is building first ball and roller bearing plant in Ukraine at Kharkov, with capacity for 10,000 units a year. It will supply automobile, tractor and bicycle industries in Ukraine and Caucasus, should be going by end of year.

Ray Rausch, ex-top production man at Ford, will head manufacture of new Tucker Torpedo car at former Dodge-Chicago plant. Car will have rear-engine drive, weigh under 2000 lb., sell for $1000-$1300. Rausch says production will begin within six months, top output will be reached within one year.

Note from Washington: Nobody knows what to do to reduce number of strikes, but experienced persons feel that skillful mediation and arbitration, begun in early stages of disputes, is the best thing in sight. Effectiveness of cooling periods and of fact finding is increasingly questioned.

Within 2-3 years, small jet planes will carry mail coast to coast in 2-3 hours, predicts Langley Field official. This would be equal to the speed of the sunrise.

French have ordered 8750 box cars (weighing 20 tons each) and 4000 gondolas (of 30 tons each) from American Car & Foundry. Gondolas will be all-steel welded. Netherland State Railways have bought 500 diesel omnibus chassis from Crossley Motors, Manchester, England.

Battle royal is developing between induction-heating and gas-equipment companies for hardening, brazing and billet-heating work. Both sides claim ability to apply heat selectively, economically and in production-wise manner.

Latest on surpluses: 90,366 machine tools have been declared surplus, of which 30,906 are in Cleveland area and 19,348 in Detroit. RFC has approved 777 dealers and 553 are being reviewed. Eventually RFC wants 3000, but industry believes that 1500 will be enough. Plan for rebuilding surplus machines now being discussed.

Russians reported testing twin-motor, two-seater metal helicopter, with airscrew placed on either side of fuselage and joined to it by metal frame. It can stop within 3 ft. of ground and remain there to load passengers by rope ladder.

Germany should not build any machine tools, recommends British Engineers' Association. Those essential to German domestic economy should be imported by license.

First break in stiff price controls in Canada is suspension of ceilings on wide range of products and services, including used machine tools. This is expected to cut red tape in disposing of surpluses.

International Harvester is setting up Manufacturing Research Center with 350 men hand-picked from IHC plants all over the country. It will be concerned with actual manufacturing methods and cost-cutting. When IHC engineers turn loose a new product, the research center will specify best way of making it.

More rapid depreciation of machinery to permit manufacturers to charge off the cost of new equipment in a shorter time than 20 years (present Treasury policy) is advocated by National Machine Tool Builders' Association. This action would allow industry to take advantage of the substantial changes in machine tool design every seven years that obsoletes much machinery in use.

Kaiser expects to make automobile bodies from aluminum sheet rolled in the Trentwood mills near Spokane, Wash., from ingots produced in the nearby reduction plant at Mead. He is leasing these plants from RFC, is planning to use Trentwood's entire capacity, enough for 3000 bodies daily.

Gaging Business

Steel Loss Effects

Although the steel strike cost the nation about 6,000,000 tons of steel before it ended, experts predict that another 4,000,000 tons that might have been produced over the next six weeks will not be made because of the time required for the industry to get back to its pre-strike operating rate of 82% of capacity. It will take over a month to lift the industry over its initial recovery rate of around 50% back to the 80% level. This 10,000,000 tons of steel lost, representing an economic loss to the nation of almost half-billion dollars, is about one-eighth of the total tonnage that had been expected for this year's production.

The major difficulty in getting the industry back to its pre-strike level is that steel production involves the synchronization of pig iron production, ingot steel output, accumulation of adequate supplies of semi-finished steel to feed various rolling mills, all of which will take time. Moreover, furnace repairs will be necessary in many cases.

As damaging as the effects of the steel strike were, causing the layoffs of thousands of workers in auto plants, the farm equipment and machinery industries, and at plants making consumers' durable goods, they might have been worse if it weren't for the fact that (1) steel inventories were higher than had been generally believed; and (2) simultaneous strikes at General Motors, electrical manufacturing plants, and farm equipment plants, served to reduce the over-all demand for steel.

Reconversion Really Starts

Barring new unsettlements, metalworking industries are prepared to reach record operating rates within the next few months. Some observers believe that the steel industry will get back to higher operations within a few months than prevailed before the strike, perhaps as high as 90%. This is due to higher backlogs facing the industry, and the price increase that permits greater production of certain items, previously restricted due to inadequate prices.

Expansion plans keynote the optimistic production goals industry has set. The steel industry itself will spend about $350,000,000 this year, chiefly for new equipment. In the auto industry, Ford plans to spend around $200,000,000, General Motors about a half-a-billion, and Chrysler around $100,000,000. The farm equipment industry also has elaborate plans, with International Harvester slated to spend $150,000,000 for new plants and equipment. Over $1,000,000,000 in government-owned plants have already been sold or leased to private industry.

Wage-Price Problems

But many small plants will be hard hit by the new wage-price formula, unless they can get speedy price relief by the OPA. Many of these plants, already shut down by lack of materials, may not reopen until they have some assurance on speedy price relief from OPA. Otherwise, they would have to begin operations at a loss and hope for OPA relief later. They face higher prices for steel, and other semi-finished products, plus the necessity to increase wages in their own plants.

Since many metalworking firms already have requests for OPA price relief pending, they will have to revise their figures in the light of new developments. In this respect, small plants are harder hit than large plants, and many will require quite some time to find out the entire range of new prices they will have to pay for raw materials before they can set the prices they will need. This may prove more of a handicap to recovering industrial production than it appears on the surface.

Once the wage-price upsetment settles, industry may only have to cope with sporadic jurisdictional disputes between the CIO and the AFL.

Tool Business Holds

Demands for machine tools continue steady, although special equipment remains in strongest demand. However, standard tools on which prompt delivery is available are enjoying favorable sales as reconverting plants are unable to secure surplus equipment fast enough. Only about 20% of government-owned machine tools expected to be declared surplus have been released thus far, and red-tape and inadequately trained staffs hamper the disposal of these items by the War Assets Administration.

Machine tool builders will continue restricted by shortages of motors and other electrical equipment.

GIDDINGS & LEWIS TAKES OVER DAVIS BORING TOOL

MILWAUKEE—The Giddings & Lewis Machine Tool Co. has acquired the Davis Boring Tool Division of Larkin Packer Co., Inc., St. Louis, Mo., and after March 1 will make all standard and special boring bars and cutters formerly made by Davis. A distributor organization has been set up to service customer needs, and a separate engineering department staffed by key Davis technicians and G. & L. engineers is already at work on standard and special boring problems.

Tire Molds Rushed On West Coast — The Los Angeles plant of U. S. Rubber is rushing production of steel tire molds to help ease shortages of civilian types of tires. A workman here is buff-finishing a tread design engraved on the mold in matrix. The steel matrices supply the curing molds for the tires

Settlement of Steel Strike Leaves Operational, Scheduling Problems

PITTSBURGH — It will take more than a month to bring steel operations back to where they were in mid-January, before the strike. Observers believe that it will be easy to get back to around 50% of capacity, but that the extra 30% will take some time. The length of time depends upon the amount of maintenance work that was accomplished during the strike, and the amount needed when the strike ended.

The settlement of the strike on the basis of 18½c-an-hour wage increase, or about 16%, was accomplished with the government agreeing to a $5-a-ton increase in carbon steel prices (9%).

The first steel made in the open hearths after the strike was not the first to be shipped in the form of finished products. Reason is that available raw materials in stock, including ingots, will be channeled into the finishing mills, until newly produced ingots tie into the flow of metal within the plant. However, it required several days to bring heating and annealing furnaces and other equipment up to the point of availability for use.

Schedules Upset

Sales officials, confronted with pressing demands for shipments from their customers, are expected to bring pressure to bear to have new ingots channeled to their respective finishing departments, creating an intensive competition within companies for the available steel. Since tin plate and sheets and strip represent the most important and largest backlog it is likely that pressures here will be so strong that demands for tonnages in these directions will prevail. It is also recognized that these are the most profitable mill items.

After tin plate and sheet mill needs are provided, there will not be enough steel for other mills for some time, so that production in these other departments will limp along for quite a period.

Fourth Quarter Delivery

Backlogs of producers are so extensive that it is believed no new orders placed now can be expected to be delivered before some time in the fourth quarter of 1946.

Even this prospect takes into consideration that some of the schedules of exports previously arranged for 1946 will not be met. A number of trade authorities believe that the domestic demand for steel is so great that any movement to export in large quantities will produce a long and prolonged howl.

OPA Restores Price Ceilings On Second Hand Machine Tools

WASHINGTON—As of February 5, 1946, the OPA restored ceiling prices on second hand machine tools to the levels in effect before Dec. 22, 1945.

Truck Bookings Decline

CHICAGO — Truck bookings continued their decline during November. New business during the month was 54% below the total for October, which in turn had been 28% below the September business. According to the Electric Industrial Truck Association, total bookings for the month were $594,173.50 and after cancellations were $543,501.25, in contrast to the total bookings of $1,297,-108 for October, less cancellations of $177,425.

Farm Equipment Industry Hit by Strikes, 1946 Output to Equal 1945

CHICAGO — Strikes, and materials shortages resulting from strikes, have forced down the major factors in the farm equipment industry. International Harvester, Caterpillar Tractor, J. I. Case, and Oliver's South Bend plant have been shut down by strikes, while Deere & Co. and Fairbanks Morse have been slowed by shortages of materials. This has knocked out production of units that would have been used for spring planting.

Moreover, this means that the industry will do well to equal its 1945 output this year, and its heavy backlog will probably be maintained into 1947. Oliver had planned to introduce its new TNT plow this spring—an implement which loosens a layer of subsoil yet keeps it under the topsoil—but the outlook is not promising, what with strikes and shortages of materials.

Backlogs Higher

Two-thirds of Chicago district manufacturers increased their backlogs in January. One-third of them produced less in January than in December, while an equal number reported a rise in output. But the over-all backlog gain indicates that the volume of new business is still outstripping the output of most plants. Compelled to run on a limited basis because of shortages caused by strikes, many plants say that they would have been better off from the standpoint of costs if they had closed altogether.

With more and more strikes settled and an increasing number of plants resuming production, the local metal trade looks for brisk business. This is partly reflected by optimistie expansion and production schedules.

Harvester Expands

International Harvester's bid of $1,353,000 for the RFC plant of Foote Brothers Gear & Machine Corp. has been approved. The factory will be used as a research center. Harvester has also taken over the malleable iron foundry of General Malleable at Waukesha, Wis.

Pullman Standard expects to build 900 freight cars a month at its Bessemer plant and later to push the total up to 1400 a month. Pullman has been able to secure orderly manufacturing out of a crazy-quilt of deliveries by setting up unorthodox assembly line practices. As many as 16 of its suppliers have been shut down at one time by strikes.

Radio Corp. has leased two Chicago plants and will make auto radios in them. Borg-Warner will expand sharply its Ingersoll Steel Division largely to make farm implements.

Machine Tool Business Steady, As Surplus Releases Increase

NEW YORK—Dealers in this area report that machine tool business for February has held up very well. Demand for special machines has been particularly strong, although volume for standard machines is also good. The latter persists despite large releases of surplus units in recent weeks, reflecting that difficulties in securing surplus equipment are still turning buyers back to the new equipment market.

One of the largest current releases of surplus tools in government-owned plants in this area was that at the Sperry plants in Brooklyn and Long Island, involving 18,000 machine tools, including many precision units never used. Other notable recent releases include the 4,000 tools at the Woodridge, N. J., plant of Wright Aeronautical, and the 2,000 tools at Bendix, North Bergen, N. J., plant.

Some dealers are buying surplus machine tools at the regular price for their own account, and then reselling them at the OPA price. By such action, these dealers are able to move swiftly in buying up large numbers of highly marketable items.

WAA Asked to Approve Special Plan To Rebuild Surplus Machine Tools

WASHINGTON — Authorization for machine tool builders to purchase surplus used machinery for rebuilding and resale with a new machine warranty was proposed by the Metalworking Machinery Advisory Committee at its meeting here with the War Assest Corp., now called War Assets Administration, which will consider the recommendation. Manufacturers said that for rebuilding they would prefer equipment built since 1940, to be purchased at a negotiated price low enough to permit its return to plants and its rebuilding.

The National Machine Tool Builders Association was asked to submit details of the proposal, including the experience of those companies that have been trying to purchase surplus equipment for rebuilding. Until now sales especially for rebuilding have not been attempted on a wide scale due to the need for speed in moving surplus equipment to reconverting plants. However, the rising volume of surplus tool releases will make possible some action on this. It is reported that trade-ins may be accepted.

Scrap Old Machines

A proposal was also made for the scrapping of special war machines and surplus machine tools over 25 years old. Regional inventories of all surplus machine tools were recommended, and the suggestion was made that the period for holding machines in priority for federal and local government purchases be shortened. In addition, it was proposed that only the smaller and simpler machines wanted by such purchasers be set aside, releasing all others.

The meeting, under chairmanship of Sterling J. Foster, vice-president, WAA, took up numerous complaints. WAA regional managers have on occasion tried to withhold dealer commissions because request for delivery came direct from the user, though the dealer had handled the sale. Watchmen have barred dealers from plants and warehouses, other obstacles have confronted them because government personnel were unfamiliar with procedure. One regional manager for RFC refused to sell surplus machines from a single plant, because he misinterpreted the dealer agreement as only covering machines in warehouses, and not those in plants.

Bad Lists Troublesome

The Detroit office of RFC insisted that dealers obtain a city license, which would have subjected them to various city ordnances. Erroneous catalog listings have caused wrong shipments to purchasers, and it was urged that steps be taken to improve descriptions and to permit removal of wrappings for inspection.

WAA took over the 12½% dealer commission plan from SPA-RFC. As of Jan. 31, 1946, 777 dealer applications had been approved, and 553 were being reviewed. Several committee members questioned RFC's objective of 3,000 dealers, and suggested a limit of 1,500. A complete breakdown of machine tools on hand, by age, as of December, 31, 1945, was presented to the committee (see table).

The Committee unanimously recommended that the advisory committee in each region help the government to get at least one man familiar with machine tools. Uniform forms and procedure were recommended.

NUMBER OF SURPLUS MACHINE TOOLS ON HAND BY AGE, AS OF DECEMBER 31, 1945
By War Assets Field Offices

Disposing Agency	Mfd. 3/1/41 to date	Mfd. from 1/1/36 and 3/1/41	Mfd. before 1936	New or unused tools	Undetermined	Total
Atlanta	248	6	5	150	1,548	1,957
Birmingham	541	51	8	32	—	632
Boston	4,039	234	361	117	77	4,828
Charlotte	107	—	2	37	12	158
Chicago	6,816	84	245	102	518	7,765
Cleveland	12,988	17,170	111	254	383	30,906
Dallas	216	24	3	78	9	330
Denver	217	3	1	—	—	221
Detroit	16,327	1,001	207	156	1,657	19,348
Helena	—	—	1	—	—	1
Houston	405	—	1	14	—	420
Jacksonville	100	2	5	1	38	146
Kansas City	1,259	74	17	9	1,116	2,475
Little Rock	14	12	2	1	—	29
Los Angeles	446	46	17	20	28	557
Louisville	65	11	26	4	80	186
Minneapolis	1,063	13	21	—	32	1,129
Nashville	172	5	8	4	481	670
New Orleans	152	12	1	2	117	284
New York	1,938	187	465	189	1,696	4,475
Oklahoma City	32	17	15	—	40	104
Omaha	204	62	55	—	—	321
Philadelphia	3,026	147	268	73	228	3,742
Portland	10	—	28	—	25	63
Richmond	249	4	40	11	83	387
St. Louis	2,034	8	23	21	775	2,861
Salt Lake City	54	—	5	227	13	299
San Antonio	49	27	37	3,772	—	3,885
San Francisco	226	10	46	65	13	360
Seattle	211	150	46	1	—	408
Spokane	4	26	0	1,289	100	1,419
TOTAL	53,212	19,386	2,070	6,629	9,069	90,366

Surplus Listings Available

WASHINGTON—District offices of the Reconstruction Finance Corp., or what is now the War Assets Adm., are prepared to place on their mailing lists persons interested in securing notices of surplus declarations of various types of equipment. This practice was started many months ago, when the service was offered to manufacturers, wholesalers, retailers, users, exporters and scrap buyers. Recently, interest in this service has been heightened, since surplus machinery dealers licensed by the government are now in a position to receive these listings.

World's Invention Exposition

CHICAGO—A World's Invention Exposition, planned to bring inventions and manufacturers together, will open April 11 for 12 days in the Chicago Arena. Both models and drawings will be exhibited, and E. K. Green is director of exhibits, with offices at 155 No. Clark St., Chicago.

Detroit Letter

Auto Industry Newcomers

The daring young man on the flying trapeze has nothing on the intrepid, brash but determined newcomers in the automotive industry. The woes that are plaguing their future competitors do not daunt them. In fact, it is perhaps the factor that encourages them, for while the entrenched group of old-time passenger car manufacturers are strikebound, either directly or indirectly, the time element is in the favor of the new entries into the lush field.

There are now several entries getting set to toss their hats into the manufacturing ring. With Kaiser-Frazer definitely in, a new group has made itself known. It is headed by Preston Tucker, a young and personable engineer who runs a tool plant in Ypsilanti, nearby. He was associated with the late Harry Miller in making racing cars and has a good background in designing.

Interest In Tucker Corp.

Tucker some time ago announced a radical new passenger car built along racing lines. He called it the Torpedo and it immediately evoked wide discussion. It would have a rear engine, developing 150 horsepower. It would have a hydraulic torque-converter transmitting power directly from the engine to the rear wheels. The entire car would weigh under 2,000 pounds and sell between $1,000 and $1,300.

It all sounded far-fetched. But many persons interested themselves. And last week, Tucker showed up in Detroit with an announcement of his new firm, the Tucker Corp., and a list of the top personnel.

Rausch Joins Tucker

These included some sound, experienced automotive names. First there was Ray Rausch, former top production man of the Ford Co. Rausch had gone out with the Harry Bennett housecleaning when Henry Ford II took over full control of the company from his aged grandfather. But Rausch had charge of production in all Ford plants except Willow Run. He had been a Ford director and his reputation as a production expert was well established.

Then there was Joseph D. Burke, designated as Tucker's vice-president in charge of sales. He too was a well-known figure in the industry. He had been with Packard, Hudson, Graham, Dodge, Chrysler and Pontiac. He had gone to West Palm Beach, Fla., several years ago.

Next was Eugene L. Reason, until last year the purchasing chief for Chrysler. Lyle D. Middleton, who had been with Ford from 1919 to 1945, was to be chief master mechanic. George Lawson, who has done much of Buick's styling, will be in charge of style, art and color.

Dodge-Chicago Plant Deal

In addition, Tucker confirmed reports that he was angling for the Dodge-Chicago plant. The lease is now in Washington, waiting signature by the Reconstruction Finance Corp. He was a bit wary of talking about how much of the huge $200,000,000 layout his company would use but the lease was to be for all of it.

Rausch estimated that the new company could start making cars within six months from the time the lease was signed. He said in another six months, the plant would be in full operation.

Tools, Supplies Accessible

From anyone else, such predictions would arouse scorn. But Rausch's background is a sound one. He elaborated on his statement by saying that there were 14,000 general purpose tools held in the Dodge-Chicago plant which his new company would use in their operations. Some special purpose tools would have to be ordered but would not present too much of a problem, he said.

In addition, Rausch disclosed that he had already lined up enough suppliers to ensure quick production once the company got under way. Body presses would not be needed, he pointed out. He had two established body builders and one new one ready to make the radically-designed body for the Torpedo.

GM Troubles Extended

On the strike front, the General Motors dispute appeared headed for an uneasy peace for a while. The settlement of the United Electrical Workers strike at 18½ cents was followed by GM's raising its previous offer of 13½ cents to the same level.

When GM did make the 18½-cent offer, it was promptly rejected by Reuther in no uncertain terms.

Whatever the outcome of the negotiations, which are a mere by-play with the steel strike now over, it will be an uneasy peace which will follow. Reuther has stated frankly that if he accepts the 19½ cents, it will only be temporary and he will be back after the rest of the 30 per cent he insists GM can pay. Bitterness is rife as never before and is growing every day the strike keeps on.

Material Shortages Hamper Ford Operations—These workers, laid off February 1 from the Edgewater, N. J., Ford plant, as a result of material shortages mirrored the widespread impact of the steel strike, upon metal processing plants. This was ironical for these Ford employees who had settled their pay dispute with the company

$1,070,681,381 In Surplus Plants Sold or Leased By R. F. C.

84 plants sold for 71% of cost and 17 more sales approved. Major sales listed

WASHINGTON—Up to the end of 1945, the Reconstruction Finance Corporation had arranged for the sale or lease of $1,070,681,381 worth of government-owned plants. Of the total, some 11% were sold for an average yield of 71.3% of the cost price. Many plants were sold for the actual original cost to the government. Major transactions are listed herewith.

As of December 31, 1945, RFC had sold 84 plants, costing the government $122,025,118, for $87,063,482, and had tentatively approved the sale of an additional 17 plants costing $46,193,267. At that time, 30 plants worth $147,892,092 had been leased for anywhere from three months to five years, and some were even leased on a month-to-month basis. Another 17 plants, worth $63,920,545 had been tentatively approved for leasing. The wartime contractors operating 184 other plants, worth $690,650,359, had been given approval for the continued operation of these properties subject to termination notice, usually of 30 days.

75% Pay Cash

WAA finds in a recent survey that about ¾ of plant purchasers are paying the full amount in cash. Surplus officials are impressed by the large sums available for investment in plants, and no doubt for other purposes. Young men come into RFC's Washington headquarters and blithely announce they have millions in backing. Some of them have "wild and impractical" ideas. Among the other quarter of purchasers, the trend is to pay 15% or 20% down, with terms on a quarterly basis. Service men get special attention but no price preferences.

One complex problem in the sale of surplus plants is local taxes, which go right on, though the plants may be shut down. In some cases these taxes are very high, and justifiably so, because wartime operations have burdened the cities' services and caused them substantial expenses. But prospective earnings under private management are often not proportionate to the tax load, and some sales have been killed as a result. For obvious reasons the Federal Government has not seen fit to interfere, and tax problems are left to negotiation between the local governments and local managements. It seems likely that in some cases the tax makers will want

DISPOSAL OF INDUSTRIAL PLANTS AND SITES
(As of December 31, 1945)

Project	SALES Cost of Plants	SALES Sales Price	Purchaser
Barnes, W. F. & John Rockford, Ill.	$552,145	$552,145	Barnes, W. F. & John
Engr. & Research Corp. Riverdale, Md.	116,579	116,579	Engr. & Research Corp.
Kollsman Instrument Div. Square D Co., Binghamton, N. Y.	239,456	175,000	General Aniline & Film Corp.
Oilgear Co. Milwaukee, Wis.	152,453	45,000	Eschweiler & Eschweiler
General Motors Corp. Buffalo, N. Y.	3,070,992	2,550,000	General Motors Corp.
Micromatic Hone Corp. Detroit, Mich.	395,340	325,000	Micromatic Hone Corp.
Canton Drop Forging Massillon, Ohio	793,797	275,000	Massillon Alum. Co.
Kelsey Hayes Wheel Co. Plymouth, Mich.	1,870,352	1,435,124	Evans Products Co.
Eaton Mfg. Co. Massillon, Ohio	528,480	291,302	Eaton Mfg. Co.
Die-Typing Corp. Pontiac, Mich.	297,773	92,617	Budd Wheel Co.
Briggs Mfg. Co. Detroit, Mich.	3,278,922	2,315,956	Briggs Mfg. Co.
American Broach & Machine Co. Ann Arbor, Mich.	77,009	70,000	American Broach & Machine Co.
General Electric Co. Erie, Pa.	2,195,985	1,529,413	General Electric Co.
General Electric Co. Erie, Pa.	1,977,032	1,423,220	General Electric Co.
General Electric Co. Fort Edward, N. Y.	814,867	589,500	General Electric Co.
General Electric Co. Decatur, Ill.	734,592	550,000	General Electric Co.
General Electric Co. West Lynn, Mass.	382,969	323,000	General Electric Co.
General Electric Co. Trenton, N. J.	1,837,581	1,408,872	General Electric Co.
Aviation Corp. of America So. Williamsport, Pa.	73,019	65,000	Ray-O-Vac Madison, Wis.
Brown Fence & Wire Co. Adrian, Mich.	165,432	109,578	Service Steel Co. & Brown Fence & Wire Co.
American Type Founders, Inc. Newark, N. J.	316,865	325,000	Bri-Test Prod.
Ex-Cell-O Corp. Detroit, Mich.	694,358	515,000	Detrex Corp.
Aeronautical Products, Inc. Washington Court House, Ohio	360,345	219,622	Aeronautical Products, Inc.
Thompson Aircraft Products Co. Euclid, Ohio	7,416,271	5,000,000	Thompson Aircraft Products Co.
Ex-Cell-O Corp. Highland Park, Mich.	3,388,587	1,574,255	Ex-Cell-O Corp.
Buffalo Arms Corp. Buffalo, N. Y.	1,891,238	1,436,656	American Machine & Foundry Co.
Murchey Machine Tool Co. Detroit, Mich.	99,453	95,000	Simon Engr. Co. Hazel Park, Mich.
General Motors Corp. Melrose Park, Ill.	20,823,048	13,750,000	International Harvester Co.
Consolidated Vultee Aircraft Corp., Allentown, Pa.	199,760	200,000	General Electric Co.
Ohio Crankshaft, Inc. Cleveland, Ohio	811,484	608,000	Ohio Crankshaft Inc.
General Motors Corp. Danville, Ill.	2,261,761	1,587,910	General Motors Corp.
Michigan Tool Co. Detroit, Mich.	306,618	250,000	Michigan Tool Co.
N. A. Woodworth Co. Detroit, Mich.	122,460	105,700	N. A. Woodworth Co.
Ex-Cell-O Corp. Highland Park, Mich.	1,217,177	950,000	Ex-Cell-O Corp.
General Electric Co. Cleveland, Ohio	1,501,951	807,350	White Motor Co.

to reduce their rates, if necessary, to hold production and wages in their regions.

RFC saved itself a lot of trouble by owning nearly all the land on which its plants are situated. Acquisition of the land took time, and caused a little criticism because of the urgent war need. Navy, on the other hand, leased most of its plant land, and obstinate owners now can demand removal of the buildings, some of which are of permanent design.

Few Multiple Tenancies

RFC-WAA's hope of making multiple tenancy work, on either leases or sales, has not been realized. Many of the general-purpose plants are too large for single peacetime use. It was thought likely that local groups would form to buy or lease these large facilities and subdivide them, the tenants sharing the cost of power, water, and other services. So far, such groups have tended to set their tenants' shares of purchase cost or rental too low. In at least two cases, WAA has sent its own agents into communities to develop satisfactory multiple tenant programs.

If the prospective purchaser is a lessee, he has an option to purchase at a stipulated price. But if he feels that, considering WAA's known appraisal formula, he can get a lower price, or if he wants to purchase only part of the leased property, he can waive his option and negotiate a deal.

Option Aspects

If he waives the option he risks being out-bid by a competitor when the property is advertised for 14 days prior to final disposal, under "gold fish bowl" publicity policy. But very often he gets the plant for less than option price. Non-lessees often pay more than the option price, and lessees who have waived their options have paid more. All prices are either option prices or are negotiated; WAA never sets them.

In event a proposal seems sound, but financing is not available, WAA sells on terms or recommends an RFC loan. Loans may be extended at 4% up to 15 years, depending on the down payment and on credit factors. Lease terms, depending on circumstances, are usually 8% on the current "reproduction cost of land and buildings," and 12% on machinery already in the plant. Lessee must pay taxes, insurance, and "reasonable maintenance." Leases are written for varying periods.

Some leases provide an option to purchase at a price computed on the agreed value of the property at time of lease, less an agreed amount per year for depreciation, or less 4% interest per year less all rent paid and less interest of 4% per year on rental payments, whichever yields most to the Government. Option to purchase is implied in all leases.

"Interim" leases are made with wartime lessees, to keep maintenance and employment going pending negotiations. These are usually written for not more than six months, or they contain a 30-day cancellation clause.

WAA is using every means to effect sales rather than leases.

Project	Cost of Plants	Sales Price	Purchaser
Fairchild Engine & Airplane Corp., Jamaica, L. I., N. Y.	1,949,754	1,225,000	Ideal Novelty & Toy Co., L.I.,N.Y.
Western Electric Mfg. Co. Scranton, Pa.	698,939	400,000	General Electric Co.
Minneapolis-Honeywell Regulator Co., Chicago, Ill.	968,281	1,101,500	Leaf Bldg. Corp. Chicago, Ill.
Square D Co. Plant, Kollsman Instrument Co., Flushing, L. I., N. Y.	510,854	417,000	Universal Slide Fastener Co., Inc.
Howarth Pivoted Bearing Co. Philadelphia, Pa.	182,430	190,000	Smaller War Plants
Ford Assembly Plant Norfolk, Va.	2,135,000	1,620,000	Ford Motor Co.
Murray Corp. of America Scranton, Pa.	5,134,847	1,200,000	Civic Group in Scranton
Tung Sol Lamp Works, Inc. Weatherly, Pa.	485,448	322,090	Tung Sol Lamp Works, Inc.
Brown &Bigelow Fuse Plant St. Paul, Minn.	272,874	185,728	Brown & Bigelow
Nash Kelvinator Corp. Lansing, Mich.	2,718,444	1,137,526	Motor Wheel Corp.
Continental Aviation & Engr. Corp., Detroit, Mich.	85,595	93,010	Samuel D. Keywell, Inc.
The Oilgear Co. Milwaukee, Wis.	317,794	270,442	The Oilgear Co.
Curtis-Wright Corp. Indianapolis, Ind.	5,931,968	2,500,000	Eli Lilly & Co.
Vard, Inc. Pasadena, Calif.	765,784	509,000	Vard, Inc.
Gear Grinding Machine Co. Hamtramck, Mich.	215,443	146,000	Motor Prod. Corp. Hamtramck, Mich.
Vinco Corp. Detroit, Mich.	316,515	250,000	Vinco Corp.

COMMERCIAL LEASES

Project	Lessee	Cost of Facilities	Term
Otis Elevator Co. Buffalo, N. Y.	Otis Elevator Co.	2,714,000	1 year
Eaton Mfg. Co. Saginaw, Mich.	Eaton Mfg. Co.	890,800	5 years
Edwd. G. Budd Mfg. Co. Philadelphia, Pa.	Edwd. G. Budd	12,600,000	5 years
Studebaker Corp. Chicago, Ill.	Western Electric Co.	5,689,545	5 years
Continental Aviation & Engr. Corp., Muskegon, Mich.	Continental Av. & Engr Corp.	1,325,525	1 year
Ford Motor Co. (Willow Run) Ypsilanti, Mich.	Kaiser-Fraser Corp.	25,000,000(est)	5 years
North American Aviation, Inc. Dallas, Texas	Robt. McCullock & H. L. Howard	.....	Mo. to Mo.
Interstate Aircraft & Engr. Corp., DeKalb, Ill.	General Electric Co.	472,563	5 years
Bendix Aviation Corp. Teterboro, N. J.	Bendix Aviation Corp.	1,217,662	2 years
Westinghouse Electric Co. Baltimore, Md.	Westinghouse Electric Co.	1,964,928	4 years
Jacobs Aircraft Engine Co. Pottstown, Pa.	Firestone Tire & Rubber Co.	8,198,324	3 years 2 Mo.
St. Louis Ordnance Div. McQuay-Norris Unit St. Louis, Mo.	Lincoln Engr. Co.	.....	Mo. to Mo.
Eaton Mfg. Co. Cleveland, Ohio	The Gabriel Co. Cleveland, Ohio	771,967	5 years
United Engr. & Foundry Co. New Castle, Pa.	United Engr. & Foundry Co.	25,160,497	3 years 3 Mo.
Ford Motor Co. Ypsilanti, Mich.	Mechanic Handling System, Inc., Detroit	.....	Mo. to Mo.

TENTATIVE APPROVALS OF SALES

Project	Cost of Plants	Purchaser
Superior Tube Co. Evansburg, Pa.	$ 534,374	Superior Tube Co.
General Motors Corp. Bedford, Ind.	2,765,765	General Motors Corp.
Grumman Aircraft & Engr. Port Washington, N. Y.	1,792,358	Cairns Corp.
Curtis-Wright Corp. Cheektowaga, N. Y.	18,134,432	Westinghouse Electric Co.
N.A. Woodworth Co. Ferndale, Mich.	628,089	Peninsular Metal Prod. Corp., Detroit.
Perfex Corp. Milwaukee, Wis.	192,706	Milwaukee Electric Tool Co.
General Electric Co. Bloomfield, N. J.	968,879	Tung Sol Lamp Works, Inc.
Nash-Kelvinator Corp. Lansing, Mich.	1,415,808	John Bean Mfg. Co. Lansing, Mich.
Chandler Evans Corp. Dayton, Ohio	1,183,676	United Aircraft Prod. Inc., Dayton
Warner Gear Div. Muncie, Ind.	2,693,750	Borg Warner Corp.
Bendix Aviation Corp. #1 Philadelphia, Pa.	3,457,384	Philco Corp.

TENTATIVE APPROVALS OF COMMERCIAL LEASES

Project	Lessee	Cost of Facilities
Extruded Metals, Inc. Grand Rapids, Mich.	Reynolds Metals, Inc. Grand Rapids, Mich.	$6,729,723
Kinner Motors Co. Plant Glendale, Calif	Kinner Motors Corp.	650,000
Wright Aeronautical Corp. Woodridge, N. J.	Wright Aeronautical Corp.	23,973,700
Atlantic Steel Castings Co. Crum Lynne, Pa.	Chester Electric Steel Co.	1,051,536
General Machinery Corp. Hamilton, Ohio	Fisher Body Div. G.M.C.	477,769
The Aviation Corp. Detroit, Mich.	Federal Motor Truck Co. Detroit, Mich.	529,344
General Motors Corp. Kings Mill, Ohio	The Electric Auto-Lite Co., Toledo, Ohio	3,349,964
Emerson Electric Mfg. Co. St. Louis, Mo.	Emerson Electric Mfg. Co.	6,079,173
Aluminum Co. of America Kansas City, Mo.	The Vendo Co. Kansas City	2,540,138
Aluminum Co. of America Burlington, N. J.	Alum. Extruded Prods. Co.	250,000
Bohn Aluminum Brass Corp., Los Angeles, Calif.	Harvey Machine Co.	8,205,148

INTERIM LEASES

Name of Lessee	Approximate Cost of Plant	Termination
Bell Aircraft Co. Burlington, Vt.	$ 2,497,009	30 days' notice
Bohn Aluminum & Brass Corp., Adrian, Mich.	16,935,000	30 days' notice (Ext. to 2/28/47)
Aeronautical Products, Inc. Detroit, Mich.	1,239,716	"
Precision Castings Co. Fayetteville, N. Y.	466,573	"
Fairchild Engine & Airplane Corp., Jamestown, N. Y.	1,651,456	"
Reynolds Metal Co. Louisville, Ky.	5,001,850	Indefinite
National Acme Co. Cleveland, Ohio	3,812,000	30 days' notice
General Motors Corp. Flint, Mich.	39,252,100	"
Continental Motors Corp. Garland, Texas	3,559,510	"
Lake City Malleable, Inc. Ashtabula, Ohio	5,080,604	"
Crucible Steel Casting Co. Milwaukee, Wis.	2,042,389	" "
Omaha Steel Works Omaha, Nebr.	$ 669,000	30 days' notice
Eaton Mfg. Co. Battle Creek, Mich.	12,898,248	"
Aluminum Forgings Erie, Pa.	3,702,448	7/1/46
Revere Copper & Brass Baltimore, Md.	7,775,825	Fill present orders
Tyson Bearing Corp. Massillon, Ohio	1,317,989	30 days' notice
Raytheon Mfg. Corp. Newton, Mass.	1,040,067	"
Tantalum Defense Corp. No. Chicago, Ill.	5,343,574	"
Auto Specialties Mfg. Co. St. Joseph, Mich.	3,715,473	"
Putnam Tool Co. Detroit, Mich.	386,300	"
Copperweld Steel Co. Warren, Ohio	10,070,042	"
Copperweld Steel Co. Warren, Ohio	649,782	"
Copperweld Steel Co. Warren, Ohio	1,905,820	"
Copperweld Steel Co. Warren, Ohio	7,276,755	"
China Aircraft San Francisco, Calif.	440,665	"
Republic Aviation Corp. Farmingdale, L. I., N. Y.	16,716,381	"
Wellman Bronze & Aluminum Co., Cleveland, Ohio	717,424	"
Higgins Aircraft Corp. New Orleans, La.	31,100,033	"
Towmotor Corp. Cleveland, Ohio	332,215	"
Ohio Crankshaft, Inc. Cleveland, Ohio	2,716,000	"
Ohio Crankshaft, Inc. Cleveland, Ohio	8,886,330	"
Jack & Heintz Bedford, Ohio	3,046,292	"
Jack & Heintz Bedford, Ohio	1,536,246	"
Jack & Heintz Bedford, Ohio	7,146,287	"
Douglas Aircraft Co. El Segundo, Calif.	14,074,316	"
Douglas Aircraft Co. Los Angeles, Calif.	636,639	"
Douglas Aircraft Co. Santa Monica, Calif.	8,723,577	"
Rohm & Haas Co. Knoxville, Tenn.	3,370,269	"
Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.	1,061,705	"
A. C. Gilbert Co. New Haven, Conn.	496,582	"
Cincinnati Shaper Co. Cincinnati, Ohio	1,082,000	"
Perfect Circle Co. Richmond, Ind.	6,059,283	March 9, 1946
Royal Typewriter Co. Hartford, Conn.	392,249	30 days' notice
Ahlberg Bearing Co. Chicago, Ill.	800,000	"
Blaw-Knox Co. Pittsburgh, Pa.	2,146,853	"
Timken Roller Bearing Co. Columbus, Ohio	9,172,680	"
General Electric Co. Tell City, Ind.	1,007,910	"
Utica Drop Forge Co. Utica, N. Y.	737,378	"
Bellanca Aircraft Corp. New Castle, Del.	288,202	"
Bellanca Aircraft Corp. New Castle, Del.	1,474,971	"

Name of Lessee	Approximate Cost of Plant	Termination
Beech Aircraft Corp. Wichita, Kans.	$3,610,637	30 days notice
Campbell, Wyant & Cannon Foundry Co., Muskegon, Mich.	3,047,954	"
Michigan Steel Castings Co. Detroit, Mich.	171,825	"
Cross Gear & Machine Co. Detroit, Mich.	281,747	"
Reynolds Metal Co. Louisville, Ky.	2,352,561	"
American Welding & Mfg. Co. Warren, Ohio	1,152,100	"
Majestic Radio & Television St. Charles, Ill.	880,179	5/31/46 or 90 days after completion of Navy contracts
Wyman-Gordon Co. Harvey, Ill.	12,391,165	30 days notice
P. R. Mallory & Co. Indianapolis, Ind.	2,221,200	"
Onsrud Machine Works, Inc. Chicago, Ill.	221,266	"
Hanchett Mfg. Co. Big Rapids, Mich.	497,209	30 days' notice
National Bronze & Aluminum Foundry Co., Cleveland, Ohio	2,164,969	"
Reinke Machine & Tool Co. Hillside, N. J.	187,498	Lessee to exercise purchase option
P. R. Mallory & Co. Indianapolis, Ind.	265,639	30 days' notice
Titan Metal Mfg. Co. Bellefonte, Pa.	1,432,798	"
Bendix Aviation Corp. South Bend, Ind. & Owosso, Mich.	12,785,371 2,819,733	" "
Wheeling Bronze Casting Wheeling, W. Va.	437,835	"
Worthington Pump & Machine Corp., Buffalo, N. Y.	2,737,856	"
Lawrance Aero. Corp. Linden, N. J.	1,703,705	"
Albion Malleable Iron Co. Albion, Mich.	1,812,283	"
Worthington Pump & Machinery Corp., Buffalo, N. Y.	2,590,311	"
Indiana Steel Prod. Co. Valparaiso, Ind.	764,751	"
Wallington Tube Co. Wallington, N. J.	2,345,028	15 days' notice
Fitchburg Engr. Corp. Fitchburg, Mass.	750,000	30 days' notice
Pipe Machinery Co. Cleveland, Ohio	$ 420,000	30 days notice
Southern Aircraft Corp. Garland, Texas	1,245,130	"
Babcock & Wilcox Tube Co. Beaver Falls, Pa.	275,000	"
Axelson Mfg. Co. Los Angeles, Calif.	1,633,798	"
Babcock & Wilcox Tube Co. Alliance, Ohio	2,839,495	"
Babcock & Wilcox Tube Co. Beaver Falls, Pa.	1,027,394	"
Morton Mfg. Co. Muskegon Hgts., Mich.	528,070	"
Air Cruisers, Inc. Clifton, N. J.	259,954	"
Timken Roller Bearing Newton Falls, Ohio	938,200	"
S. & S. Tool & Mfg. Co. Detroit, Mich.	162,000	"
Bell & Howell Co. Lincolnwood, Ill.	2,280,141	"
Metal-Mold Magnesium Corp. Cedarburg, Wis.	202,380	5 days' notice
Electrol, Inc. Kingston, N. Y.	1,132,967	30 days' notice
Babcock & Wilcox Tube Co. Beaver Falls, Pa.	163,483	"
Reed-Prentice Corp. Worcester, Mass.	979,183	30 days' notice
Pacific Tube Co. Philadelphia, Pa.	2,425,627	"
Muskegon Motor Specialties Co., Muskegon, Mich.	125,000	"
Liberty Planers Hamilton, Ohio	649,412	"
The New Britain Machine Co. New Britain, Conn.	440,757	"
General Electric Co. West Lynn, Mass.	19,901,411	"
General Electric Co. Dover, Ohio	91,600	"
The Champion Machine & Forging Co., Cleveland, Ohio	4,060,984	"
Canton Drop Forging & Mfg. Co., Canton, Ohio	5,794,605	"
Aeronca Aircraft Corp. Middletown, Ohio	1,149,518	"
Romec Pump Co. Elyria, Ohio	506,364	"
The New Britain Machine Co. New Britain, Conn.	2,413,636	"

Steel Stamping Industry Asks OPA Price Relief, Long Deferred

CLEVELAND — The announcement in Washington of a price increase of $5 a ton in steel brought an immediate protest from the metal stamping industry, through the Pressed Metals Institute here. T. J. Smith of that organization wired Washington asking that a hearing be arranged for his group, representing a $500,000,000 industry with 6,000 plants using 8,000,000 tons of steel annually.

The concern of the stamping industry is heightened by the fact that it has sought price relief from the OPA for many months without success, and the steel price increase only complicates matters further. Last August, the industry had been promised an 8% price increase, but on September 11th, the price relief was granted on old and modified stampings, while the formula established for new stampings represented an actual 5% increase over the 1941 base. Moreover, the industry was told that the increases were only to apply for 90 days, while the OPA explored the possibilities of further price rises. But further relief has not been forthcoming.

Higher Prices Sought

Stampers are irritated because the 8% price increase did not apply to auto stampings, although OPA had lifted control on all passenger car components in August leaving service part stampings to be billed at 1941 prices under formula MPR 452. The industry wants all price controls lifted on stampings, except for those stampings which are end products. If it can't get that, it will press for a price increase closer to 20% instead of the current 8% rise allowed.

Warner & Swasey to Reopen Apprentice Machinist School

CLEVELAND—Warner & Swasey Co. is reopening its apprentice machinists' school at the Cleveland plant as soon as enough young men (aged 18-20) qualify for the four-year course.

Instead of apprentices being sent from one department to another, the company is inaugurating a new feature by training first-year apprentices in a department of their own, enabling them to receive more detailed training at the start from those in charge. During the first year, the apprentice works on actual production, learning to operate standard machine tools. After the first year, the apprentices will be sent to every department of the plant for apprentice work, with one or two evenings a week spent at Fenn College, Cleveland, for engineering studies.

British Engineers Want German Output Limited to Parts, Patents Controlled

LONDON — German industry should be controlled by rigid supervision of imports of raw materials, by a ceiling on total production, by limiting operations to simple parts and subassemblies, by policing research and development, and by curtailing exports from Germany by a system of licenses or some other quota arrangement, according to the British Engineers' Association. This association is believed to express the opinion of British industry in general.

Germany As Subcontractor

In recommending that German manufacture be limited to simple parts and subassemblies, the association proposes that German factories work as subcontractors to British or allied firms. These firms, responsible for final assembly, would control design and development. Thus opportunities for technical development in Germany would be small and a reservoir of skilled personnel capable of starting war industries could not be built up. Industrial capacity also would not be accumulated capable of being converted to production of military equipment. Limitation of exports would be in keeping with desires of British manufacturers, who in prewar days were holding their own against Germany in foreign markets.

The association recommended that reparations take several forms. One would be factory equipment made in rehabilitated German factories to supply urgent needs in Britain. Another would be goods made by new factories specially built for the purpose in Germany, employing German materials and labor. Still another would be acquisition of German patents and data concerning latest advances in research, design and technique.

Controlling Nazi Patents

In dealing with German-owned patents, the association suggests that (1) those in Britain that lapsed during the war should not be reinstated; (2) those kept in force should be cancelled if there is no non-enemy interest; (3) where a patent has been kept alive by a non-enemy licensee, it should be sequestered but preserved for the protection of the licensee; (4) German interest in patents only partly owned by Germans should be sequestered; (5) patent applications of German nationals at present on file would be made available to British industry, unless publication would be inadvisable on grounds of national security; (6) Germany should be made to declare and render up patents taken from allied owners and pay royalties due for working the inventions during the war; (7) By a moratorium British subjects should be enabled to reinstate patents in Germany which lapsed during the war; and (8) Germany should be compelled to assign to the Allies all German-owned patents in neutral countries, or alternatively, arrangements should be made with neutral countries to cancel patents covering inventions freed from protection elsewhere.

Practical difficulties of applying industrial controls to Germany are immense. Imposition of a ceiling on German production, for example, would produce reactions on British industries and overseas markets.

ASSOCIATION NEWS

W. R. White, Jr., a director of the **National Tool & Die Manufacturers Association** and chairman of its committee of government relations, has been appointed by Secretary Henry A. Wallace to serve on the Small Business Advisory Committee. Mr. White is a vice president of the Midwestern Tool Co., Chicago.

The Illuminating Engineering Society is preparing a Lighting Handbook, scheduled for issuance in October, under the direction of **Robert McKinley**, editor. Every phase of lighting will be discussed in the book, which is being prepared by authorities in the various fields. Also included in the book will be a 200-page manufacturers' reference section.

The **Ohio Equipment Distributors Association** has recently been formed by machinery dealers in that area with headquarters in Columbus. **P. L. Patterson** of Cleveland was named president, while **M. W. Kilcorse** of the Kilcorse Machinery Co., Toledo, was named vice president.

Gordon J. Berry, vice president of the Electric Products Co., Cleveland, was elected 1946 president of the **Electric Industrial Truck Association** at a recent meeting in New York City to succeed **E. W. Allen** of Thomas A. Edison, Inc. Also, **F. J. Shepard**, treasurer of the Lewis-Shepard Sales Co., Boston, was elected vice president.

Chicago Production Show To Be Held March 20-22

CHICAGO — Emphasizing new advances in industrial production, tools, materials, instruments and miscellaneous equipment, the Chicago Technical Societies Council is sponsoring The Chicago Production Show, March 20-22. The show will be held in the Exhibition Hall of the Stevens Hotel, concurrently with the Council's annual conference, which will consist of a series of 48 panel sessions. The theme of the show and sessions will be "Production for Profit" with authoritative speakers representing most fields of science and technology.

Canadian Steel Workers Seek Raises; Strike Effects Felt

OTTAWA—As steel strikes in the United States threatened to tie up a wide range of steel-using plants in Canada, Dominion steel workers began a drive for wage increases and other concessions. Leadership of the CIO-United Steelworkers planned a coordinated drive against Canada's three major steel producers, Steel Co. of Canada at Hamilton, Algoma Steel Corp. at Sault Ste. Marie, and Dominion Steel & Coal Corp., Sydney, N. S.

Their demands were: a $33.60 weekly minimum, a $2.64 increase with adjustments for skilled and semi-skilled workers, a 40-hour week instead of 48, union security, two weeks vacation with pay after five years service. Steel companies were ready to argue they could not raise wages without higher steel price, which would upset the entire price structure.

Production Hampered

Meanwhile, the steel strike in the United States forced the reestablishment of steel controls here. With many Canadian factories dependent upon the United States for steel, machinery and spare parts, effects of the strike threatened the construction, farm implement, and motor car industries.

The new steel controller has asked steel producers to step up output with the realization that some sizes and shapes are not made in Canada at all.

Surplus Tool Sales

Partly as a result of industry being given first priority on surplus machine tools, Canada's War Assets Corp. reported that January sales set a new record, topping the previous monthly high of $2,326,000, set in November. In all other categories of war surplus, government agencies, municipal, federal and provincial, are given first priority.

CANADA RAISES DUTY ON PRECISION LATHES

OTTAWA—Effective February 14, precision tool room lathes, 16 in. and 18 in. swing, became dutiable at 25% when entering Canada from the United States. The former rate was 10%. The change came about on a ruling that the lathes formerly classed as not made in Canada are now "of a class or kind made in Canada." Lathes of this type are produced by Canada Machinery Corp. of Galt, Ont.

Washington Bulletin

Surplus Upsets Continue

Installation of Lt. Gen. Edmund B. Gregory as Administrator of the War Assets Administration, in charge of both policy for and sales of surplus war goods, will not necessarily end the confusion that has persisted ever since before the war's end. WAA, as an "independent" executive agencyfi will have to ask funds of Congress, which undoubtedly will take the opportunity to pass judgment on Gregory's policies, particularly with reference to the touchy business of scrapping and salvaging useless equipment. Transferred funds will last WAA till fiscal 1948.

First the Surplus Property Board, then the Surplus Property Administration, meaning Stuart Symington, dictated surplus disposal policy under which various federal agencies conducted actual sales. Then virtually the entire sales function was transferred to RFC, with SPA still formulating policy. To clear RFC of entanglements, War Assets Corporation was created, as an RFC subsidiary, to handle both policy and sales, with SPA fading out of the picture. Desiring a free hand to apply his vast experience, and with the full blessing of RFC, the former Quartermaster General will open the doors of his War Assets Administration, formally as part of the Office of Emergency Management but actually reporting only to the President, on March 25.

Senate May Finally Act

With the public squeezed between management and labor in the strike slowdown of production, and the Administration trying to buy its way out of dilemma with higher prices from citizen pockets, sentiment in Congress to limit the power of unions and business over the national economy is increasing. The Case strike control bill, passed by the House, was in hearing at this writing before the Senate Education and Labor Committee, with small chance of action in time to affect the current shutdowns. The Committee also concludes hearings on Ellender bill, which embodies the President's fact-finding proposal, and on the Ball bill, which is a substitute for the original Ball-Burton-Hatch bill, and provides, in addition to fact-finding, a cool-off period and injunctions for violations.

National Research Bill

White House forces have managed to break the deadlock in Congress between the government planners, headed by Sen. Harley M. Kilgore, and the science group, represented by Dr. Vannevar Bush and Sen. Warren J. Magnuson, in legislation to authorize a national research foundation. A new bill is being introduced which will provide: the Kilgore plan for a 17-man advisory board of scientists, with an administrator, candidates for which job will be picked by the board or by the President; retention of patent rights by private research contractors and by non-profit private research contractors; federal aid for social science projects.

HELLER IS NEW DIRECTOR OF EQUIPMENT DIVISION

WASHINGTON—C. R. Heller has been named Director of the Equipment Division of the Civilian Production Administration, succeeding Mr. Beshers. CPA's Equipment Division has jurisdiction over the reconversion operations of the following industries: automotive, construction machinery, service equipment, transportation equipment, shipbuilding, utilities, tools, farm machinery and general industrial equipment.

NACA Stress Tests

National Advisory Committee for Aeronautics, Langley Field, Va., laboratory, opened to visitors, including a representative from AMERICAN MACHINIST, after five war years, has much to show of interest outside of aeronautics. For example, a small riveted box-beam structure of aluminum alloy, easily held in one hand, was subjected to 560,000 pounds compression in a hydraulic press before it failed. Another structure of similar material partially failed in a twisting collapse, but sprang back to true shape when the pressure was released. NACA's Cleveland engine laboratory is producing important data on metals to withstand unprecedented high-temperature-stress tests in jet compressors and turbines, and high temperature in combustion chambers and nozzles of jet engines.

Atomic Energy Controls

Congress is preparing to act on atomic energy, and there is considerable support for the McMahon bill, which replaces the May-Johnson bill, which was defeated in committee by the federation of atomic scientists. The War Department, recognizing defeat of its stand for May-Johnson, seems now prepared to go along with the McMahon measure, with the important exception that decisions of the proposed civilian commission, affecting military applications, be submitted for approval of the Joint Chiefs of Staff. This still means military control of atomic weapons, and it could block the McMahon theory of civilian control. . . . Some critics ask why, if other countries are to get data on the bomb tests, they should not contribute part of the millions in costs.

For Jap Scrap-piles—These Jap tankettes and other equipment are being accumulated at such centers as the Tokyo Ordnance Depot, former arsenal warehouse center, for checking and study by U. S. Army officers and ordnance personnel. Later on, such war equipment will be scrapped to provide steel for the partial reconstruction of Japan.

Metal Show Sets Stage for Peacetime Processing

Visitors found cost-cutting ways of using materials and new methods for mechanizing shop processes. Keen interest was displayed in induction vs. gas heating, metal finishes, control devices, cutting tools and inspection devices

CLEVELAND—Unsettled conditions and travel difficulties affected the character and attendance of the 27th National Metal Exposition, held in the Public Auditorium from February 4 to 8. Once again, many of the leading producers of metals, and of heat-treating and welding equipment, refrained from taking space or removing the wraps from important new developments. So the Metal Show had more of a production character than usual. The 30,000 visitors who circulated among 350 booths found a wide range of subjects of interest. Equipment purveyors emphasized labor-saving methods. And there were many exhibits of tools, inspection devices and certain categories of machines.

There was no Metal Show in 1945. In a sense, the February exposition was a stop-gap until conditions improve and many firms that customarily exhibit are in a position to do so. Plans are now being laid to hold another show this year—in November at Atlantic City.

Heat-treating Battle

From the recent exposition, it is evident that a battle royal is developing between induction-heating and gas-equipment concerns for hardening, brazing and billet-heating work. Both sides claim ability to apply heat selectively, economically and in a production-wise manner through development of feeding arrangements for the workpieces.

In induction heating, major improvements pertain to the use of mechanical work-handling devices. Induction Heating Corp. displayed a chain-driven fixture conveyor, which carried ice-skate blades past the heating coil at the rate of 300 pieces per hr., hardening them to Rockwell 59 C for controlled depth. This concern also has a two-turn coil arrangement for hardening step-down work, such as crankshaft journals; a vertical through feed for shafts say 3 to 4 ft. long, and a circular-feed table. Lepel High Frequency Laboratories displayed a rotary table for hardening and brazing operations, and states that a hopper can be used. To provide maximum output of station-type induction heaters, Lepel has an automatic transfer switch, so that the operator is free to load and unload pieces. Scientific Electric Co. has applied the rotary table principle to gear hardening, and demonstrated the value of fixtures that are preloaded with complex components of an assembly and then brazed by induction heat.

Gas Heating Units

But the gas people were on their toes. American Gas Furnace Co. has a machine in which gas-jets are arranged in adjustable manifolds for directing spots of heat exactly where needed for brazing. The demonstration machine was set up for brazing 32 joints in 16 return bends at the header end of an evaporator at the rate of 40 assemblies per hour—quite an advance in production as compared with torch brazing each joint. And the Selas Corporation of America demonstrated a "machine tool," a double-ended indexing machine for hardening and drawing ball-pein hammer heads to controlled depth at the rate of 180 parts per hr. This exhibit was intended to show how the company's gas-burner equipment and mechanical principles can be combined in many ways for different products. The Gas Appliance Service Co. also demonstrated this idea, showing how 3000 small parts can be brazed per hour on a rotary-table machine.

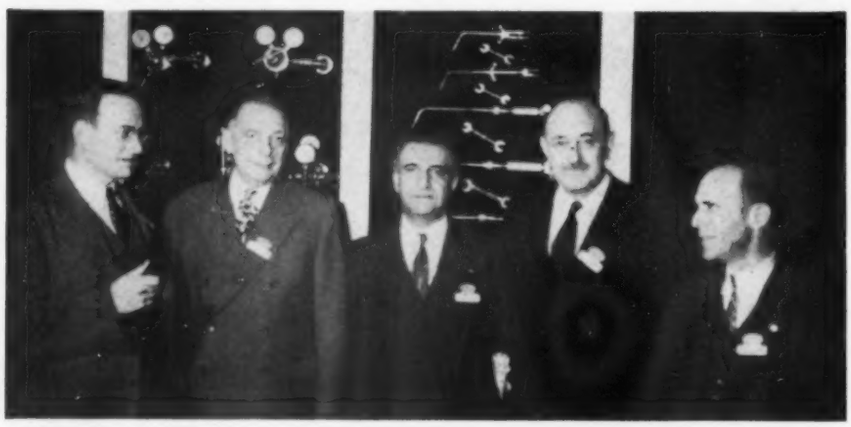
An extensive line of induction heaters for hot working and forging operations has been introduced by Budd Wheel Co., and the Detroit concern has improved its induction equipment for hardening internal surfaces.

Stanley C. Horosco and J. C. Millies, vice-presidents of Republic Drill & Tool, were on hand to discuss the merits of the "jet" deep-hole drill

There were not many new furnaces at the Show. Harold E. Trent Co. is now selling a small furnace complete with automatic controls for use in the small shop for heat-treating high-speed steels. This company also has a low-headroom electric furnace capable of handling 150 lb. of steel per hour at 1850 F.

Heat Control Devices

Refinements in heat control and combustion were evident. North American Mfg. Co. has a burner valve that can be preset to gas Btu. to give certified combustion over a wide range of turndown. Thus all burners in a furnace fire the same, none is maladjusted to cause scaling or decarburization. Lindberg Engineering Co. has a new generator that produces a neutral gas of low dew point for use in furnace brazing, or in carburizing if propane is added. An



J. J. Lincoln, director of sales services; H. W. Reade, manager, apparatus sales department; A. H. Yoch, technical sales division; G. V. Slottman, manager, technical sales division; and J. F. Callahan, assistant advertising manager; all of Air Reduction, confer on flame-cutting problems at the company's booth

Quonset Hut Attracted Metal Show Interest—This 40-by-60 foot Stran-Steel Quonset hut loomed large among the 450 exhibits at the National Metal Show. Offered by the Great Lakes Steel Corp., the Quonset is regarded as one answer to industrial needs for quickly-erected, economical buildings

electronic input controller for electric furnaces, developed by Automatic Temperature Control Co., stabilizes temperature more quickly when parts of different mass are loaded.

Despite the absence of some large metal producers, the Show did attract exhibits of improvements in older metals and new ideas. Carpenter Steel's casehardening thread-gage steel is now being used as an all-around steel for the "tough" jobs, where uniform hardening, shape holding and low warpage are useful. Great Lakes Steel revealed that high-tensile "N-A-X" steel is easily formed for bumpers and is now cold-rolled to a high finish to eliminate buffing before plating.

New Cutting Steel

In the field of tool materials, Braeburn Alloy Steel Corp. showed a new cobalt-moly-tungsten steel called "Congo" for cutting very hard steels and heat-treated forgings. "Borcoloy" Grade 6 is a new centrifugally cast hard tool tip offered by Panelectric Corp. Fansteel Corp. had "Fanweld," a high-tungsten facing for die edges. Vanadium Alloys Steel Co., which is replacing much of the molybdenum in its high-speed steels with tungsten, now has a 4.5% vanadium, 1.25% tungsten and 1.30% chromium tool steel.

A new leaded commercial bronze was featured by American Brass Co. in the form of hollow hex bars for nuts, the bars not needing drilling before tapping. Revere Copper & Brass has a free-cutting brass alloy, in which 0.25% tellurium increases machinability. Chace Thermostatic Co. exhibited a high-temperature bimetal that possesses good life at 1200 F. (a new temperature field for bimetals) and a more active material for temperatures between —90 and 500 F. National Lead is making "Fluxrite" a wire solder with solid flux in four equally spaced slots around the periphery for improved release of flux ahead of melted solder.

The "electronic bloodhound," a tracing device for flame cutting, was the central feature of the Air Reduction Co. booth. This equipment makes it possible to copy profiles from blueprints or silhouettes, eliminating the need for solid templets. Also displayed was a new and larger Radiagraph, capable of cutting through 60-in. of steel. Both the horizontal arm and the torch are water cooled.

Linde Air Products' "Unionmelt" machine for automatic arc welding was exhibited with an improved control box. Among its advantages is a high-frequency current superimposed on the welding current to start the arc without the use of steel wool or other metallic contact. Examples of flame spinning, flame hardening and flame priming were also shown.

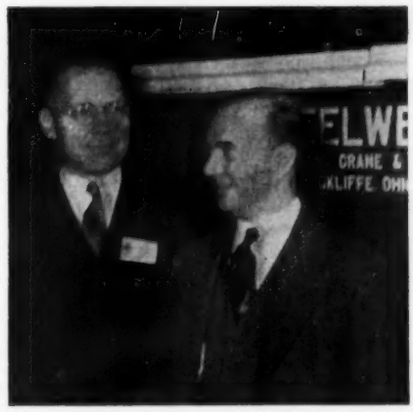
Electronic Flash Welding

Sciaky Brothers' booth contained a machine for the quality flash butt welding of aluminum tubing. An electronic timer controls the welding cycle to conform to the greater current intensity and lower melting point characteristic of aluminum alloys as compared to steel. Another exhibit was a seam welder for steel barrels; finished work from this machine withstands a drop of 17 ft. on a welded joint without leakage. Still another Sciaky innovation is the balancing of three-phase current into a single phase to reduce line demand and increase the power factor in resistance welding.

The Nelson stud welder has been incorporated into production units particularly designed for quantity manufacture. The gun itself originally found wide use in shipyards for arc welding studs directly to steel plates. Now air-actuated fixtures adapt single or multiple guns for automatic operation. One unit uses magazine feed and automatic ejection.

Circular Power Shear

A number of improved metalworking machines and tools were exhibited. Steelweld Div., Cleveland Crane & Engineering Co., has a power shear in which the upper knife travels in a circular path. Clearance of the pivoted blade is adjusted with a crank. Two sizes of metal saws were shown by Motch & Merryweather. One of them can be equipped with automatic cycling and cuts ferrous



E. L. Peterson and H. T. Florence, general manager, Cleveland Crane & Engineering (Steelweld) disclosed an unusual principle in metalshearing equipment

bars to 1¼ in. diameter. The No. 2 machine has hydraulic feed and clamping, provision for automatic feed, and will handle 6 in. pieces.

Torrington Manufacturing Co. showed a large vertical-spindle machine with rotary table for finishing spring ends to close tolerances. Monroe Tool & Mfg. Co. exhibited a heavy-duty "Millgrinder" that presents work on a swinging table to a cup wheel for generating flat surfaces. An improved design of a Swiss-type grinder for carbide-tipped, single-

point tools, milling cutters, reamers, counterbores, and end mills was displayed by E. F. Hager & Son.

Kennametal displayed a disk file for facing light alloys, die-castings, and plastics, at speeds of 1200 to 1800 r.p.m. of the 12-in. cutter body, which is fitted with double-cut segments of cemented carbide. Wendt-Sonis showed reamers with full-length carbide-tipped flutes.

Attention was attracted to Republic Drill & Tool's working display of the "Jet" drill, a deep-hole drill which has coolant grooves milled in the lands. Frederick Hart & Co. have a "Hartool" holder in which carbide tips can be clamped, avoiding use of brazed single-point tools. Anti-friction bearings are used in Lempco Products' improved die sets to avoid play of guide posts and bushings.

War-developed testing equipment available for the first time for general use was put on exhibition. Sperry Products and Brush Development Co. revealed details of supersonic units for non-destructive testing of parts for internal defects. A "Metal-sorter" developed by Control Equipment Co., rubs a standard sample against an unknown piece, and if no potential is developed the parts are identical metallurgically.

Hardness Tester

Hardness determination of thin metals, plated surfaces, hard and brittle materials, carburized or nitrided surfaces is done with a "Tukon" tester made by Wilson Mechanical Instrument Co. and calibrated in Knoop hardness numbers. Tensile testing machines included Tinius Olsen's "Pend-U-Lever" universal tester with a maximum stroke of 30 in. and 20,000 lb. capacity; and W. C. Dillon & Co.'s unit for tests up to 100 lb.

Federal Products displayed a 1-in. indicating micrometer, and automatic sorting attachment for its electronic comparator, air gages, and an electro-mechanical comparator with signal lights or audible means to indicate tolerance. Jack & Heintz had electronic comparators, height gages and ball sorters.

The sodium hydride descaling process recently developed by E. I. duPont de Nemours & Co., for descaling stainless steel and alloy steels is moving into the fields of cleaning welding flux from assemblies.

CINCINNATI MILLING OFFERS SHARES TO PUBLIC

CINCINNATI — Cincinnati Milling Machine Co. has offered 230,000 shares of its stock for public sale, representing the first time any of its 850,000 shares has been placed on the market. The company's 1945 sales exceeded $45,000,000.

Spotting the Air News

Faster Than Sound

Speed of sound varies between 700 and 900 m.p.h., depending on temperature. The speed of sound is called Mach No. 1, and all other speeds, in supersonic research, are stated in percentages below and above 1. Scientists at NACA, and elsewhere, are now trying to cross the unknown barrier at and near Mach (pronounced Mock) No. 1, or the transonic range. At that point all the known laws of airfoil lift, drag, and control, begin to go haywire. Shock waves appear, and air ceases its laminar flow around "streamlined" or raindrop shapes which have served for years, in wings, bodies, and propeller blades. Two new shapes seem to point the way across the transonic range. One is the knife-edge airfoil, displacing the elongated raindrop shape. The other is sweepback wings, which conform to the angle of shock waves. The shock wave is caused by the compressibility of air: the air piles up in front of the airfoil, its reactionary forces shooting off at an angle instead of flowing along the surfaces.

Once the transonic range has been passed, the speed of airplanes, or space machines, seems to be without foreseeable limit. Rockets have already traveled at rates up to 3000 and 4000 m.p.h. But this was achieved, not by efficient airfoil design, but by the use of force, just as projectiles are thrown from guns. It is not, and has not been, known what happens, aerodynamically, to such projectiles.

The XP-81, shown below, does better than 500 miles per hour.

Jet And Gas Turbines

The two major studies in high air speeds are transonic air foils, and the aerodynamics of jet and gas turbine engines, and combinations of the two. Whereas the behavior of air on propellers and conventional wings is the relatively old science of external aerodynamics, what happens inside of jet compressors, jets, and propeller-driving gas turbines is a relatively new science. Resulting data, and its implications may go far outside the field of aviation, into other power applications.

Design and production of jet engines and gas turbines by General Electric, Westinghouse, and automotive companies, means substantial business losses to the old-line aviation engine industry. The new producers came in, by government request, while the old-liners were sweating out reciprocating engines for war. The boys have charged it off to bad luck.

Aircraft Engine For Autos?

Beech Aircraft, of Wichita, is developing an experimental automobile, in which an air-cooled 90 h.p. Franklin aircraft engine will drive an electric generator, which in turn will actuate small electric motors on each individually sprung wheel. Light, aircraft-type construction is feature; selling price perhaps around $5000; six passengers. Amazingly light and small electric motors have been developed for the aircraft industry. NACA recently revealed a 100 h.p. motor that appeared to be about 10 by 20 inches.

Gas-turbine and Jet-Powered XP-81—First to fly with a gas turbine engine designed for propeller drive, the new Consolidated Vultee XP-81 is powered by two engines. Besides its G-E gas turbine unit, located in its nose, the plane also has a G-E jet engine in the tail. Both engines operate independently with a combined power equal to that of the four engines of a B-29.

Names in the News

Gwilym A. Price

Gwilym A. Price, former vice president of Westinghouse Electric Corp., Pittsburgh, has been elected president of the corporation to succeed **George H. Bucher,** who has resigned to become vice chairman of the board of directors. Mr. Price was elected a vice president in 1943 and last May was named executive vice president. He has been a member of the corporation's board of directors for the past year.

Carl J. Snyder has been appointed general staff master mechanic of the Chrysler Corp., Detroit, succeeding **D. F. Flater,** who has resigned. During the war Mr. Snyder served as master mechanic of Chrysler's atomic bomb work and as general master mechanic of the company's Dodge Chicago plant.

J. B. Wagstaff has been appointed vice president of the DeSoto Div., Chrysler Corp. Mr. Wagstaff has been general sales manager since 1936 and will continue to direct sales activities.

George P. Torrence, president, and **John S. Clark,** vice president and treasurer, of the Cleveland Pneumatic Tool Co., Cleveland, have resigned. Both men have also been directors of the company.

Edwin R. Fellow II has been appointed export manager of The Fellows Gear Shaper Co., Springfield, Vt.

Howard F. Carver has been named sales manager of the Gleason Works, Rochester, N. Y., while **William M. Woodruff** has been made export manager.

George E. Miller, formerly vice president in charge of sales and engineering for the Smith Power Transmission Co., has been appointed assistant sales manager of the machine division of the Osborn Manufacturing Co., Cleveland.

Roland A. Sherwood, formerly assistant to the executive vice president of the American Locomotive Co., New York City, has been named assistant to the president, **Robert B. McColl.**

William G. Pinkstone, formerly vice president of The West Co., Philadelphia, has become vice president of the General Grinding Wheel Corp. and executive vice president of West Abrasives, Inc., Philadelphia.

Arthur H. Starrett has been elected president of The L. S. Starrett Co. to succeed **David Findlay,** who has retired after 55 years with the company. Mr. Starrett has been with the firm over 40 years and was made a director in 1922 and a vice president seven years ago. At the same time, **William J. Greene,** vice president in charge of sales, was elected vice president and director of sales.

A. H. Starrett

L. E. Osborne

L. E. Osborne, formerly vice president and general sales manager of the steam division of Westinghouse Electric Corp., has been elected senior operating vice president.

A. J. Kerr, general manager since 1944 of the Rockwell Manufacturing Co., Pittsburgh, has been elected vice president in charge of sales.

George L. Draffan, executive vice president of the Ohio Brass Co., Cleveland, for eight years, has been elected president to succeed **Charles K. King,** who has served in that capacity since 1928.

Karl B. Kaiser, head of the research and development departments for The Ingersoll Milling Machine Co., Rockford, Ill., has also been appointed chief tool engineer.

William J. Weaver, vice president in charge of operations of The Ansonia Electrical Co. since 1942, has been elected president of the wholly-owned subsidiary of Noma Electric Corp. At the same time **A. P. Lunt,** chief engineer since 1943, was elected vice president.

S. Floyd Stewart

J. Robert Kelley

S. Floyd Stewart, chief engineer since 1941 of The Leece-Neville Co., Cleveland, has been elected vice president in charge of manufacturing.

J. Robert Kelley, vice president and assistant to the president, has been appointed executive vice president of Manning, Maxwell & Moore, Inc. Mr. Kelley has been active in the export division since 1933.

Bert Conway, formerly vice president in charge of manufacturing of The Aviation Corp., has become associated with Joseph W. Rothmeyer, Detroit.

E. R. Jacobsen has been named sales manager for the Paul & Beekman Metal Stamping Div., The Portable Products Corp., while **A. G. Koenig** is now general sales manager of another Portable division, the C. J. Tagliabue Instrument Div.

Ned Hills, Toledo representative for the Sheffield Corporation's gage and precision measuring instrument lines, has broadened his field coverage to include machine tools.

Donald H. Gilmore has joined the magnesium sales staff of the Dow Chemical Co., Cleveland, while **Francis T. Furman** has been transferred from Midland, Mich. to the New York sales office. At the same time, **Robert L. Featherly** returned to Dow as a member of the magnesium sales staff on cathodic protection.

Fred J. Tobias, research and metallurgical engineer, has joined Advance Pressure Castings, Inc., Brooklyn, to take charge of production and metallurgy. Also **Alfred F. Gauron** has been appointed field engineer for the New England district with headquarters at Amesbury, Mass.

A. J. Quinn was recently elected president of Brooks Equipment Corp., Hoboken, N. J.

J. A. Williams, former executive of the Curtiss-Wright Corp., Buffalo, has been appointed general manager of the United Aircraft Products, Inc., Dayton, Ohio.

Joseph E. Cain has been elected president of P. R. Mallory & Co., Inc., Indianapolis, Ind. He succeeds **Philip R. Mallory,** who has been named chairman of the board.

W. A. Finn has been appointed export manager of the Worthington Pump and Machinery Corp., Harrison, N. J. to succeed **George Gellhorn.**

J. B. Mills, works manager of the Ohmer Corp., Dayton, Ohio, has retired after 25 years with the company.

Edward E. Helm, general sales manager of The Reliance Electric & Engineering Co., Cleveland, has been elected sales vice president.

Harold A. Chamberlin has been appointed field engineer for the Alliance Manufacturing Co. in the New England territory. His office will be at 31 Milk St., Boston, Mass. Also, **Porter Turner** has been named field engineer in the New York and Philadelphia territory, with headquarters at 401 Broadway, New York City.

R. H. Cannon, former abrasive engineer for the Ohio area, has been appointed merchandising engineer for the Abrasive Div., Norton Co., Worcester, Mass.

BUSINESS ITEMS

The Barium Steel Corp., Canton, Ohio, is making plans to acquire **Republic Industries, Inc.,** New York City, and its four operating units: **The Geometric Stamping Co.,** Cleveland; **Jacobs Aircraft Engine Div.,** Pottstown, Pa.; **Kermath Manufacturing Co.,** Detroit; and the **Porcelain Steels Div.,** Cleveland.

Acorn Tool & Manufacturing, Inc., 501 York St., Cincinnati, has been formed by **Edwin H. Stern** to make tools, dies and jigs.

The International Nickel Co. of Canada, Ltd., has formed a development and research section, located at 25 King St. W., Toronto. The division will be staffed by **Dr. Gordon S. Farnham, A. S. Tuttle** and **H. J. Butterill.**

The **Ryan Aeronautical Co.,** San Diego, Calif., has changed the name of its exhaust systems division to the stainless steel manufacturing division.

Precision Welder and Machine Co., Cincinnati, has appointed **The Weber-Semmer Co.,** 5108 Liberty Ave., Pittsburgh, as its representative in western Pa., and Eastern W. Va. At the same time, **Thomas P. Moran** was appointed Detroit district manager with headquarters at 6432 Cass Ave.

Harris-Karp-Goldsmith & Co., Cincinnati, has acquired control of **The Smith & Mills Co.,** Cincinnati.

Tool Designers, Inc. has been formed in Cincinnati to make jigs and tools for the machine tool industry. **Carl J. Heimbach** will be president and secretary of the firm.

The Kelly Reamer Co., Cleveland, has appointed **A. R. Shevlin** as sales and engineering representative for eastern Conn. and R. I. He is located in the Park Square Bldg., Boston, Mass.

Wm. McKinley Manufacturing & Engineering Co., Ltd., 2967 No. Speer Blvd., Denver, Col., has recently been formed with **William McKinley** as president and general manager and **Glen Glander** as vice president.

Star Electric Motor Co., Bloomfield, N. J., has opened a New England district sales office at 1430 Massachusetts Ave. Cambridge, Mass. **Elliot W. Knight** has been appointed district manager.

The Dayton Precision Manufacturing Co., Dayton, Ohio, owned by **Otto L. Spaeth** since its formation five years ago, has been sold to three Dayton business men, **Robert L. Brownell, Jack M. Taylor** and **L. J. Meyer.**

Buffalo Machinery Co., Inc., Buffalo, N. Y., has appointed **Tool Service for Industry,** 140 No. Dearborn St., Chicago, as its distributor for torque control couplings in northern Ill., southern Wis., northwestern Ind. and eastern Iowa.

Airco, Inc. has been formed by **Don Campbell,** president, and **John A. Diehl,** secretary-treasurer, to manufacture domestic stokers and other heating equipment. Headquarters will be either in Cincinnati or Hamilton, Ohio.

The Williams Tool & Engineering Co., Indianapolis, Ind., has purchased **The Dues Machine Co.,** Ansonia, Ohio, manufacturer of farm equipment.

Frontier Industries, Inc. has been formed in Buffalo, N. Y. by **Ralph F. Peo,** former vice president of the Houdaille-Hershey Corp. and general manager of the affiliated Houde Engineering Div. and Buffalo Arms Corp.

H. K. Porter Co., Inc., Pittsburgh, has acquired the **Hinderliter Tool Co.,** Tulsa, Okla., producer of oil field tools. Hinderliter Tool will operate as a division of Porter under the direction of **F. J. Hinderliter,** founder and president.

Continental Can Co. has acquired **The Fibre Can Machinery Corp.,** machinery concern of Rutland, Vt.

OBITUARIES

Earl A. Munger, 53, former president of the Durham Manufacturing Co., Muncie and Fort Wayne, Ind. and National Industries, Inc., Muncie, passed away Jan. 28. He has been associated with numerous companies, including many of the automotive firms in Detroit, and served as general manager of the Ingersoll Machine Co., Detroit.

Dan C. Swander, 67, one of the founders of the Columbia Vise & Mfg. Co., Cleveland, died Jan 27. Mr. Swander served for many years as president of the company and last year was named chairman of the board.

George J. Freedley, 78, retired president of the Cardwell Machine Co., and the Virginia Forgings & Manufacture Corp., Richmond, Va., passed away Feb. 9.

Albert K. Andrews, 67, retired president of the Andrews Steel Co., Newport, Ky., passed away recently after an illnes of several months.

Roger D. DeWolf, 66, president of the DeWolf Furnace Corp. which he established in 1932 in Rochester, N. Y., died recently.

Ernest R. Quade, 56, superintendent of the Syracuse, N. Y. branch of the Precision Castings Co. with which he was associated for many years, recently died.

John W. Bradley, 75, founder of the Bradley Pattern Works, Buffalo, N. Y., passed away suddenly.

MEETINGS

American Society for Testing Materials. Spring Meeting. Hotel William Penn, Pittsburgh, Pa., Feb. 25-March 1. C. L. Warwick, secretary, 260 So. Broad St., Philadlphia 2, Pa.

American Society of Tool Engineers. New Era Exposition. Cleveland Public Auditorium, Cleveland, Ohio. April 8-12. C. V. Briner, president, 1666 Penobscot Bldg., Detroit, Mich.

Society of the Plastics Industry. National Plastics Exposition. Grand Central Palace, New York, N. Y. April 22-27. W. T. Cruse, executive vice president, 295 Madison Ave., New York 17, N. Y.

Shop Equipment News

Manual or Semi-Automatic Control Possible With Mona-Matic Lathe

A Mona-Matic lathe designed as a manual or semi-automatic machine for doing first- and second-operation work on gear blanks, straight and flanged bushings and various types of shafts with one or more steps, is announced by Monarch Machine Tool Co., Sidney, Ohio. The front carriage can be equipped with either hand return of longitudinal and transverse movement of power-driven feed, or a semi-automatic cycle which incorporates power-driven longitudinal feed toward the headstock and rapid-traverse return. The slide will have a rapid traverse in at 100 in. per min., a feed rate from ½ in. to 13 in. per min. and power-driven rapid-traverse return to starting position. The front carriage can pass the tailstock base which can be clamped anywhere along the rear ways of the lathe bed.

The rear carriage for facing and necking work has its own motor, an electrically controlled cycle, and feeds which can be changed through pickoff gears mounted in the carriage housing. It is provided with power-driven rapid traverse in and return and, because of its independent motor drive, requires no mechanical tie-up with the front carriage.

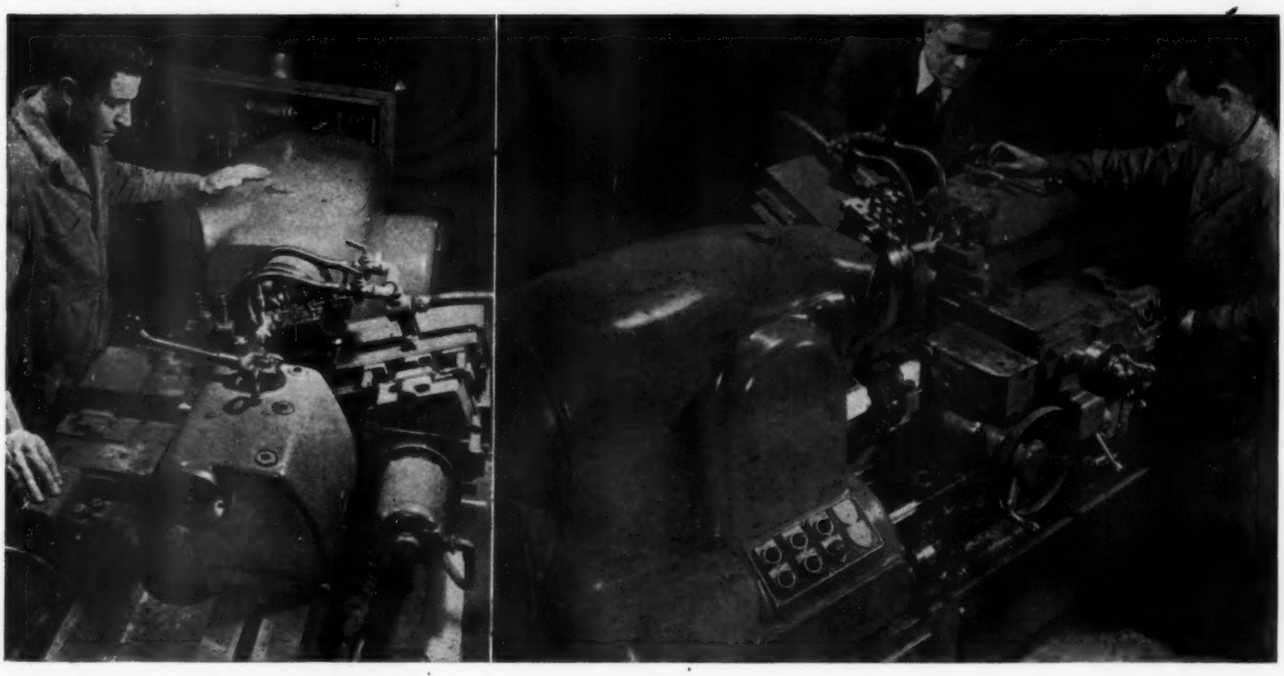
Another feature is a system of headstock lubrication by which a small quantity of oil—first reduced to mist—is circulated to keep all working parts cool, even when the lathe is operating at a spindle speed of 3,000 rpm.

Either ac. or dc. types of electrical drive can be used for operating the headstock, depending upon the type of work. For special purpose work, where it is desired to stop the spindle electrically, an ac. motor with a plugging relay can be used. Where the lathe is to be used on a variety of work, a constant-speed motor is recommended, along with the proper spindle-speed range. In this case, a multiple-disk clutch is mounted in the headstock and the starting and stopping of the spindle controlled by a lever at the right on the front carriage.

The machine can also be furnished with an automatic spindle stop which will operate from either the front or rear carriages, depending on which carriage is the last to return to its starting position. Another method of driving the headstock is through a variable-speed dc. motor having a range of 4 to 1 or more, and provided with dynamic braking.

Main drive motor, pump motor and, where dc. is used, a motor-generator set, are housed in the large cabinet base of the machine. Their controls and the controls for front and rear carriages, indicating light, and feed motor are located above the front gear box at the headstock end of the machine. Starting, stopping and inching control of both carriages, reversing and, where direct current is used, the potentiometers for controlling spindle speed when using front or rear carriages, are mounted in a box at the right of the front carriage.

The spindle has an A-1 6-in. flanged-type nose for the direct mounting of chucks and drive plates. Provision has been made on the spindle for mounting different types



of air equipment, such as cylinders and draw rods, as well as various classes of air-operated work drivers.

A heavy one-piece casting, the headstock is securely bolted to the main bed casting, its alignment being taken from a V located on the bed. A tachometer, driven through gearing from the spindle, is flush-mounted on the headstock front to indicate spindle speed. A large adapter plate on the rear of the headstock spindle permits the addition of air equipment.

The drive to the headstock is through five multiple V-belts to a large-diameter V-pulley, mounted on the first headstock drive. The starting and stopping of the driveshaft is through a multiple-disk clutch and brake for stopping and starting the spindle. The drive from the first driveshaft to the spindle back-gear shaft is through pick-off gears located on the headstock front. Four sets of change gears are provided for the complete range of spindle speeds. The drive from the spindle backgear shaft to the spindle bull gear, which is keyed directly to the spindle, is through wide-faced helical gears. All shafts are mounted on anti-friction bearings, along with the spindle which is also mounted on pre-loaded ball bearings of ample size for high-speed operation. Unit lubrication is furnished for all headstock parts and change parts.

One-Piece Base

A one-piece heavy-duty box-section casting, which extends the full length of the machine, is made up for the motor cabinet base and accessories. Provision is made at the head end of the lathe for mounting electrical controls as well as the main drive ac. or dc. motor. The chip pan and coolant pump have been put in the center portion of the cabinet leg for ease in cleaning. At the rear and center of the cabinet base is mounted a motor-driven centrifugal coolant pump. When a dc. drive motor is used, the motor-generator set is located in the cabinet base. This space is sealed to keep out all dirt and chips. Doors and panels are provided at convenient intervals in the cabinet base.

Mounted at the rear end of the headstock and covered by the headstock end guard, is an individual motor-driven lubrication unit which circulates oil to all working parts of the headstock. This unit requires a very small quantity of oil and, as the mist is condensed in the headstock, the oil is returned to the lubrication unit where it is filtered before being used again. A sight-level gage is provided at the rear of the machine for checking the oil level of the unit.

The bed is of double-wall construction. The 65° V is provided for guiding and supporting the front carriage and apron. The rear of the bed has machined flat ways for receiving the tailstock and rear carriage. A small 65° V is provided at the headstock end of the bed for aligning the headstock. Along the front of the bed is mounted a rack which is used for propelling the front carriage along the bed ways.

Tailstock

The tailstock is a two-piece design, mounted on the flat ways of the bed and locked in place by heavy-duty clamp bolts. Gibs are provided for guiding and aligning tailstock centers with the headstock spindle. Wipers are furnished on both ends of the tailstock to prevent dust and chips from getting underneath the bearing surface while moving the tailstock. The tailstock spindle is an anti-fric-type with preloaded ball bearings for supporting the work. An inserted center is also used, which is removable when the work requires a change of centers. The tailstock spindle is rack-operated and positioned and clamped by a single level located on top of the tailstock. This lever is adjustable and can be positioned to the operator's needs. Provision is also made for the mounting of air equipment, where a non-rotating air cylinder can be used for moving and clamping the tailstock spindle. The front gearbox, which provides the feed and traverse power for the front carriage, is located in front of the headstock and is a self-contained unit driven by a small ac. or dc. motor. Only one motor is required for the feed and traverse motions. The rapid traverse rate is set at 100 in. per min. and the feed rate from ⅜ in. to 12½ in. per min.

All rotating shafts are mounted on bearings and the drive from the motor to the feed rods is through a worm and differential drive, pick-off gears being provided for varying the rate of feed. The pick-off gears are located on the front of the box and are quickly changed after the change-gear cover is removed. The feeding motion is stopped and started through a magnetic clutch. Likewise, the rapid-traverse motion to drive the feed rod is controlled through gearing and magnetic clutch for the quick return of the carriage or tool slide.

Feed and traverse cycle are interlocked so the two motions will not be in operation at any one time. All moving parts, with the exception of the magnetic clutches, operate in a bath of oil and a sight-level gage is provided on the front of the machine for checking the oil level. An index plate is provided for selecting the proper gears for feed rate desired.

Mounted in a compartment on top of the gearbox are the electrical switches for starting the machine. These handle front feed; rear feed; cycle transfer; and longitudinal transverse (used when the automatic cycle is set up for the longitudinal movement of the carriage). The transverse selection is used when the automatic controls are set up for the transverse movement of the tool slide, as in a facing operation. The spindle stop transfer switch (front and rear) is used to transfer the stopping of the spindle from the front to the rear carriage, depending on which carriage finishes last. Other switches control the pump, the feed control, and the indicating light which shows that the feed-control motions are on.

Apron and Tool Slide

The front-carriage apron and tool slide are located on the front guide way of the bed and are gibbed so the carriage will not leave the bed while taking heavy cuts. Power for driving the feeding motion and rapid traverse is obtained from the feed rod which is driven by the front gearbox. The longitudinal motion is obtained through a rack feed, controlled through a multiple-disk-clutch and gearing to feed rod. The transverse motion is obtained through a cross-feed screw, multiple-disk clutch, and gearing to the feed rod.

As the apron is a one-piece casting. all shafts have a double support and all bearings are protected from dirt and other foreign matter by cap or oil seals. The bottom of the apron serves as an oil reservoir and provides the necessary lubrication for all moving parts. A sight-level gage for checking the oil level and a plug for filling the apron are conveniently located.

A declutching apron handwheel is provided for manually positioning the carriage along the ways. As only one motion can be used at a time, a single lever for controlling the longitudinal and transverse is provided for selecting the desired motion. A pull knob is also provided for changing the direction of feed of both motions. Another lever at the right of the apron is also provided for locking

It's no trick at all . . .

for the LATHE with a "MAN INSIDE"

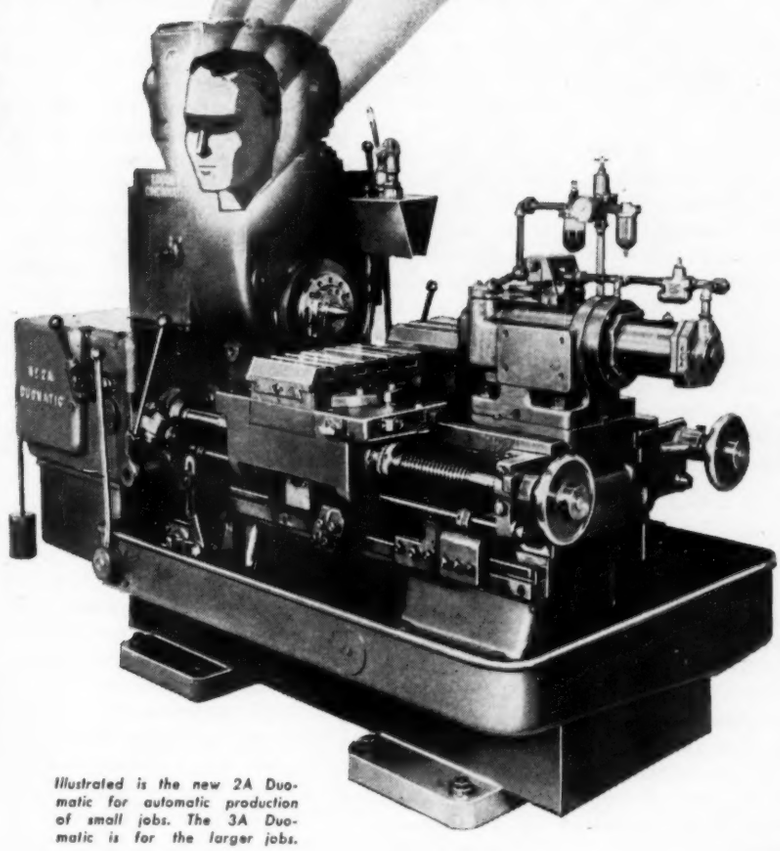
Unskilled Operator just puts in the workpiece . . . starts the cycle . . . takes out the piece when finished

On simple or complex multiple tool jobs Duomatic Lathes give CONTINUOUS OUTPUT . . . the unskilled operator merely loads and unloads the workpieces.

Diameters and lengths are automatically established, insure accurate duplication of sizes. Large or small lots are handled with equal ease. Dual tool slides, front and rear, swivel to any angle . . . enlarge the possibilities of multiple tool operations.

And because there are no cams, change of cycles takes minimum time.

These and many other features put responsibility into this automatic lathe—permit unskilled operators to do more work faster, shoot costs downward. Your L & S Engineer will give you detailed figures on Duomatic handling of your own work. Call him now. Write on your company letterhead for Bulletins No. 601 and 620.



Illustrated is the new 2A Duomatic for automatic production of small jobs. The 3A Duomatic is for the larger jobs.

THE LODGE & SHIPLEY MACHINE TOOL CO.

L & S LATHES

CINCINNATI 25, OHIO, U. S. A.

MACHINE TOOL DIVISION 3055 COLERAIN AVE. • SPECIAL PRODUCTS DIVISION 800 EVANS ST.

the carriage while the transverse slide is operating.

Enclosed on each end of the apron are the longitudinal, left feed switch, and the rapid-traverse right switch for stopping the carriage at the starting position, which are controlled by stop pluggers mounted on the front V of the bed. These stop pluggers are adjustable along the bed and are clamped into position after the carriage travel has been determined. An apron control lever for mechanically stopping and starting the spindle is mounted on the right of the apron and engages a control rod running along the front of the bed, which is mechanically tied to the multiple-disk clutch in the headstock.

Switches for controlling the rapid traverse in-feed, and rapid traverse return of the transverse slide, are located on top of the carriage. Dogs are provided on the side of the transverse slide which are adjustable and positioned for the desired travel. For manual operation of the transverse slide, a ball crank and direct-reading diameter dial graduated in increments of 0.001 in. are provided.

The rear carriage and tool slide is an independent unit mounted on the flat ways at the rear of the bed. The tool slide is set from an angle of approximately 20° towards center, so chips will not build up on the tool slide. This enables the operator to observe the tools without walking back of the machine. Square bearing surfaces are used on this slide, instead of dovetail, to receive the uplift of the cutting tool.

Feed Drives

The feed and rapid-traverse motions are obtained from a small ac. or dc. motor attached to the side of the rear carriage. The drive from the motor to the crossfeed screw, located under the tool slide, is through a series of spur gearing, worm gearing, and differential drive. The rate of feed from ⅜ to 13½ in. per min. is obtained through pickoff gears located at the rear of the carriage. This feed motion is controlled by a magnetic clutch and brake. The rapid-traverse movement of the tool slide, both in the forward and reverse direction, is set at 100 in. per min. and likewise is controlled by a magnetic clutch and brake. A series of adjustable stop dogs on the side of the rear tool slide control the various motions.

Controls for the various cycles, pushbutton stations and limit switches, are mounted in a cabinet located at the rear of the machine. Relays, starting switches, condensers and other equipment are mounted on one large panel where 110-volt ac. is available for the control relays and 115-volt dc. is supplied by rectifier for operating the magnetic clutches. Main starting switches can be used on the line voltage required by the customer. Mounted on a separate panel of the relay cabinet are electric timers for controlling the dwell of the tools on both of the front and rear carriages. These timers are adjustable and the length of dwell is set according to the job being turned.

Bayflex Wheels Cushioned To Prevent Breakage

Bayflex wheels, in which the abrasive has been incorporated in a cotton-fiber bonding material are announced by the Bay State Abrasive Products Co., 21 Union St., Westboro, Mass. These wheels have been designed for faster cutting of non-ferrous metals with less danger of wheel breakage. The increased toughness and flexibility of the bonding material provide faster cutting qualities and sufficient flexibility to permit side grinding.

Marion Portable Induction Heater Handles Small-part Soldering

A portable bench-type induction heater, produced by the Marion Electrical Instrument Co., Manchester, N. H., has been developed for clean soldering of metal to metallized glass and ceramics.

When soldering with the induction unit, solder is restricted to the work area and cleaning operations are eliminated. It is possible to accurately jig-locate parts of the assembly.

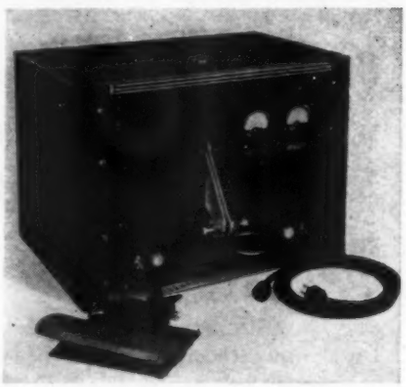
It is applicable to uses wherever small metal parts or assemblies require soldering. It consumes 775 watts at full load and 100 watts on standby. Power is drawn only when soldering is taking place.

The circuit design is such that there is no danger of sparking or radio frequency burns from the output terminals or work coil. The coupling link, operating at low impedance, is provided with a grounded center tap. The frequency, 450 kilocycles, produces no harmful radiations and the unit is completely shielded for safety and to meet FCC requirements.

The rectifier choke and plate current milliammeter are both in the grounded center tap leg of the power transformer, placing them at ground potential. Extra-heavy, high-voltage insulation wire is used throughout, and all leads are supported.

Two switches constitute the controls. No tuning control is used. One of the switches controls the power to the tube filaments and constitutes a standby switch. The other switch, also mounted on the panel, is the operating switch and controls the high voltages to the tubes. Provision has been made to operate this switch circuit by foot treadle when desired.

The circuit has been designed to provide maximum conversion of the 60-cycle power into heat. A low-impedance coupling link contributes to efficiency. Efficiency is greatest when the work to be heated has a high resistivity. In the case of low-resistivity materials, such as copper and silver, efficiencies are lower.



The Marion induction heater has interchangeable-coil supports

Each heater is accompanied by a manual which covers not only all the usual operating and service information but also the design of the work coils for fundamental shapes such as square, rectangular, round and oval. The making of such coils requires no involved calculations for the fundamental shapes. When involved work pieces are encountered, engineering assistance is available.

Although provision has been made for the use of water cooling for the work coils, such cooling is seldom required.

The Marion bench-type induction heater is furnished in a standard relay rack cabinet, and measures 15¾ x 21½ x 15 in. and weighs 150 lb. 115-volt, 60-cycle power supply is required. Line filters are incorporated so there is no danger of RF kickback in the line.

SPECIAL TAPS *can cost less than* STANDARDS

It is frequently more economical to use a special Detroit tap than a lower cost "standard". Reason for this is that DETROIT really designs specials "to the job". At Detroit that means taking into account not only general thread specifications, but characteristics of the materials to be tapped, tolerances required, whether another operation—such as drilling or reaming, or a second tapping operation—can be performed by the same "special".

It would be difficult to determine whether the machines which Detroit Tap and Tool has developed for producing all kinds of specials or the knowledge of tap design problems presented by different materials are more responsible for the outstanding success of DETROIT specials.

Our extensive field engineering force, as well as our Detroit design engineering staff are at your disposal. They will be glad to help you cut machine hours, reduce rejections, eliminate operations and improve the quality of your tapped holes.

Send us a part print of that "tough" job today.

DETROIT

TAP & TOOL CO.

8432 BUTLER AVE. • DETROIT 11, MICHIGAN

Non-releasing Tap Holder Has "Jam-Proof" Design

Barnaby non-releasing tap holder provides positive drive for large taps

A draw-out style tap holder is announced by Barnaby Manufacturing and Tool Co., 70 Knowlton St., Bridgeport, Conn. The Jam-Proof non-releasing tap holder will monitor severe tapping operations without sticking.

A small amount of float is incorporated to correct for slight misalignment in the machine. The extra-heavy setscrew will withstand long use without stripping. All parts are precision-made and hardened tap holders are available with shank diameters of ⅝, ¾ and 1 in.

Honan-Crane Expands Line Of Oil Purification Equipment

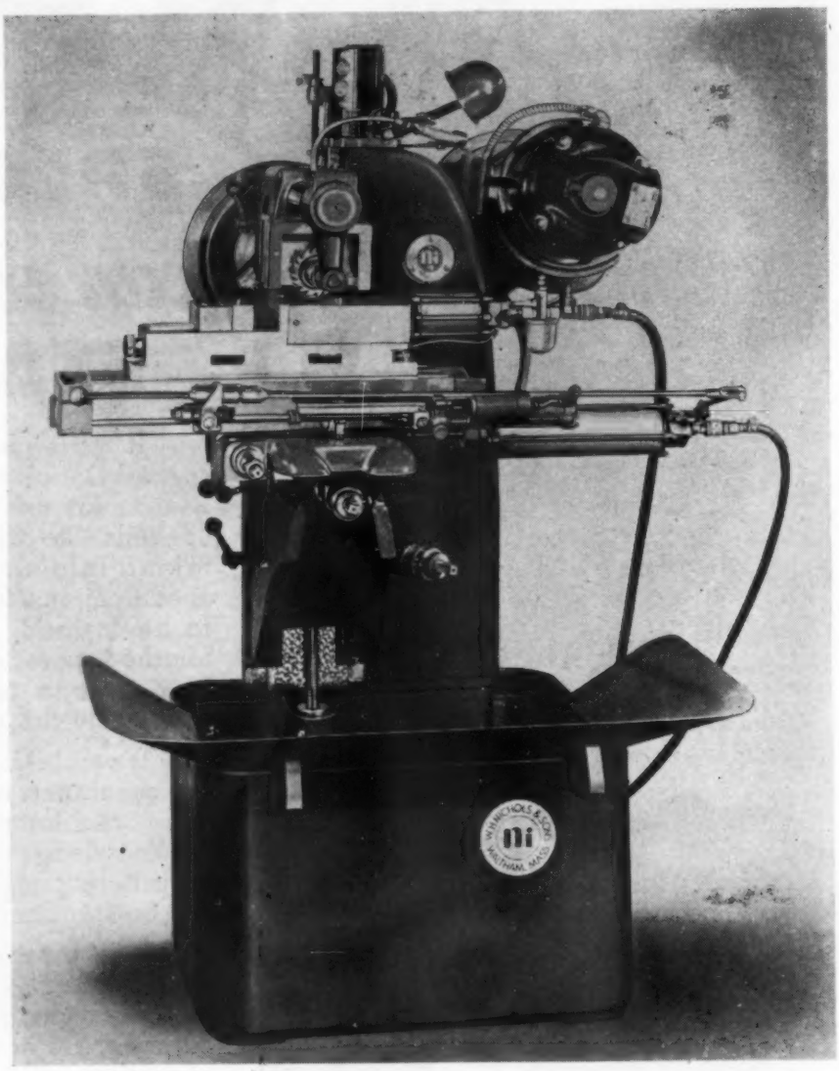
Honan-Crane Corp., 912 Sixth St., Lebanon, Ind., has added four products to its line of oil-purification equipment. The Centri-Power coolant filter is designed for stationary installation to replace or supplement machine-tool sumps. Filtering is accomplished by centrifugal action, which forces the coolant through a filter pad. Continuous operation of the filter removes abrasives as fast as accumulated and assures a clean supply of coolant at all times. Blower vanes circulate a large volume of air through the coolant stream and thus maintain the coolant near room temperature. The flow rate is 15 gpm. on mineral oils and 20 gpm. on soluble oils. This unit is 48½ in. long, 23 in. high, and 24 in. wide.

The mobile coolant filter is designed to remove, filter, and replace oils or coolants used in machine-tool operations. This filter operates directly on the machine-tool sump. It is wheeled beside the machine to be serviced; its suction hose is inserted in the sump. Flow from the return or discharge hose is used to stir up and flush abrasives and dirt. The unit is mounted on 26-in. steel wheels and is 60 in. long by 30 in. wide.

The sump cleaner is designed for the removal of oil, dirt and chips, from sumps or tanks of machine tools, gear cases, compressors, engines and quenching systems. This unit is wheeled beside the sump. When the tank of the cleaner is filled, the motor stops automatically.

The fourth unit is an oil-transfer truck and sump cleaner which functions as the mobile sump cleaner, but can also be used as an oil dispenser. Instead of a self-contained tank, this equipment is fitted with a removable barrel or closed-end drum.

Nichols Table-feed Attachment Decreases Idle Time of Millers



The maximum cutting stroke with the Nichols power table-feed attachment is 9 in. It can be operated from any shop air system carrying 75 to 175 psi.

W. H. Nichols & Sons, Waltham, Mass., announce a power table-feed attachment for the Nichols miller. This power feed attachment offers rapid approach, maximum proper cutting feed, fast table return and shut-off. The operator need only load and unload the work and can run more than one machine.

Basically, this attachment is a Bellows air-feed unit in conjunction with a Hydro-Check. Both the air and hydraulic units are infinitely variable to suit the work being produced.

For a Bruiser he was always a "Weary Willie"

He was no weak sister. But that slow, nerve-straining, muscle-cramping drudgery of hand-driving slotted screws kept him a high-cost, low-output worker. In fact, Bill and his whole department were *low* all the time . . . in production, spirits, and health . . .

. . . 'til AMERICAN PHILLIPS SCREWS stopped him from "beating his brains out"

Bill's boss got to analyzing his costs one day . . . found that his screw-driven assembly cost was the *only cost he could cut,* and that there was *only one way to do it.* So he threw out his hand-drivers and slotted screws . . . put in power-drivers and American Phillips Screws.

Now his assembly costs are down 50%. His output is at an all-time high, and so is product-quality. What's more, Bill's department has taken new interest in the job, and no longer bogs down from exhaustion toward the end of the shift. All because American Phillips Screws are:

1. "*Fumble-Proof*" . . . screw and 4-winged bit fit firmly into one straight unit that can't drive any way *but* straight. No wobbly starts, no dropped screws.
2. "*Slip-and-Slash-Proof*" . . . bit and screw can't twist apart till screw is driven up tight and flush. No spoiled work or gashed hands.

Now add a third advantage . . . American's 4-phase quality control that means higher "perfection-percentage" in every shipment of American Phillips Screws . . . and you have your top opportunity for cost-control looking you right in the face! Write.

AMERICAN SCREW COMPANY, PROVIDENCE 1, RHODE ISLAND

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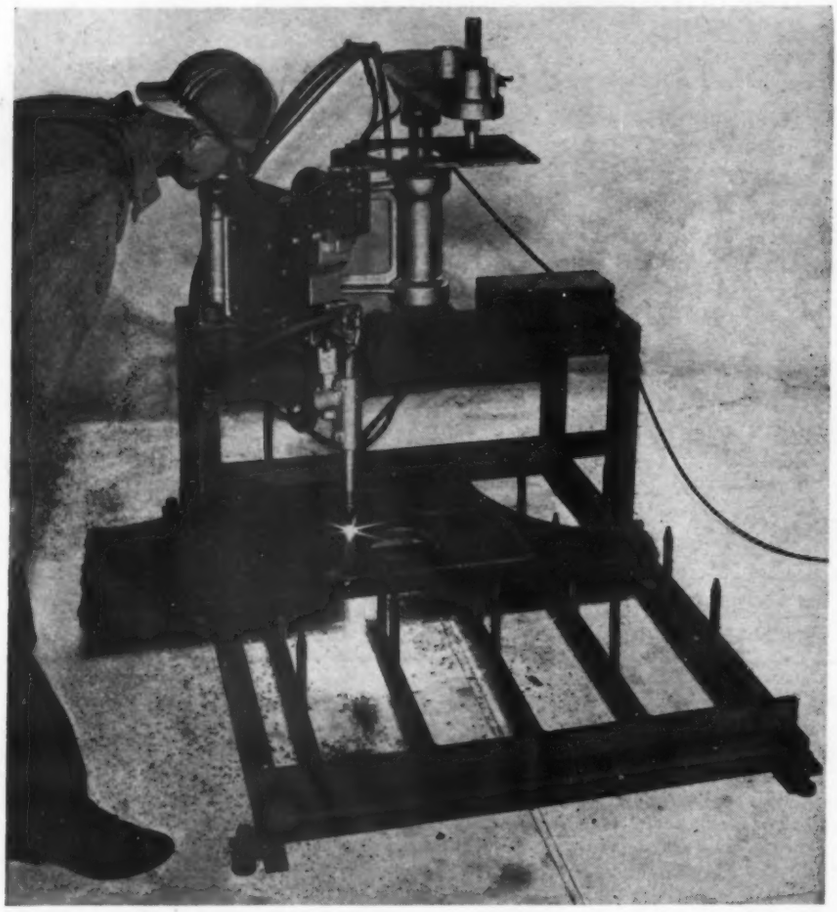
AMERICAN PHILLIPS *Screws*

Guaranteed Free from Burrs and Head Splitting

O.M.W. Contour Flame-cutter Follows Intricate Templet Forms



O.M.W. templets may be made of either plywood or steel. Plywood templets are used for small runs, steel templets for large. Steel templets can be cut from a plywood templet. The templet is held in place by a bolt

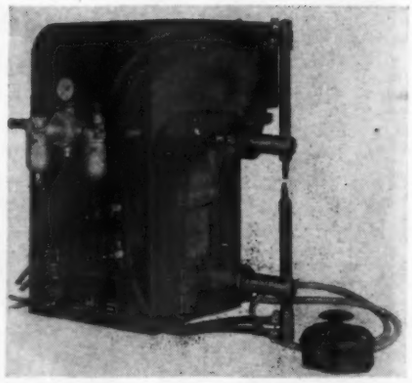
The O.M.W. flame-cutting machine manufactured by the Ohmstede Machine Wks., Beaumont, Tex., is designed to cut an unlimited variety of shapes, and the machine can be used either as a portable or stationary type. The machine is a unit and may be moved easily whether it be on a portable or stationary base.

Oversize anti-friction bearings are used in the aluminum-alloy arms and are sealed from foreign material. The variable-speed motor is equipped with a special filter to insure long life. The cutting range is 65 in. lengthwise and 30 in. laterally. Cutting speed is varied by adjusting rheostats on control panel.

Republic Hyper-Drill Provides High-pressure Coolant Flow

A drill designed for hyper-drilling is announced by Republic Drill and Tool Co., 822 So. Green St., Chicago, Ill. Laboratory tests and production drilling indicate faster penetration and greater hole accuracy with the Jet drill and its accompanying Jet director. Elapsed time is 8 sec. in drilling a ⅜-in. dia. hole 4 in. deep.

Jet drills achieve fast drilling rates with an abundance of coolant, which is delivered to the cutting lips at high velocity and pressure



The 7½-kva. midget spotwelder can be equipped with full-cycle controllers

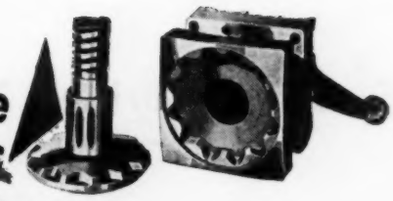
Larger Air-operated Spotwelder Added to "Universal" Line

Added to the 1-kva. and 3-kva. air-operated midget spotwelders, manufactured by David & Murphy, 5252 Broadway, Chicago 40, Ill., is the Universal USP-7½. Like the USP-1 and USP-3 it is a plug-in type and includes solenoid-valve control of air cylinder, pressure switch and can be furnished with built-in NEMA 1A electronic timer. It can also be furnished with NEMA 3B or 5B in a separate timer panel. The solenoid-valve control of the air cylinder, by adjustable pressure switch, provides a wide range for welding non-ferrous metals, wire, jewelry and 16-gage steel. The 7½-kva. is equipped with air filter, pressure gage and automatic lubricator. Initiation of welding cycle is by electric foot switch and it is equipped with water-cooled transformer and electrodes.

Gelber Live Center Made In Dead Center Sizes

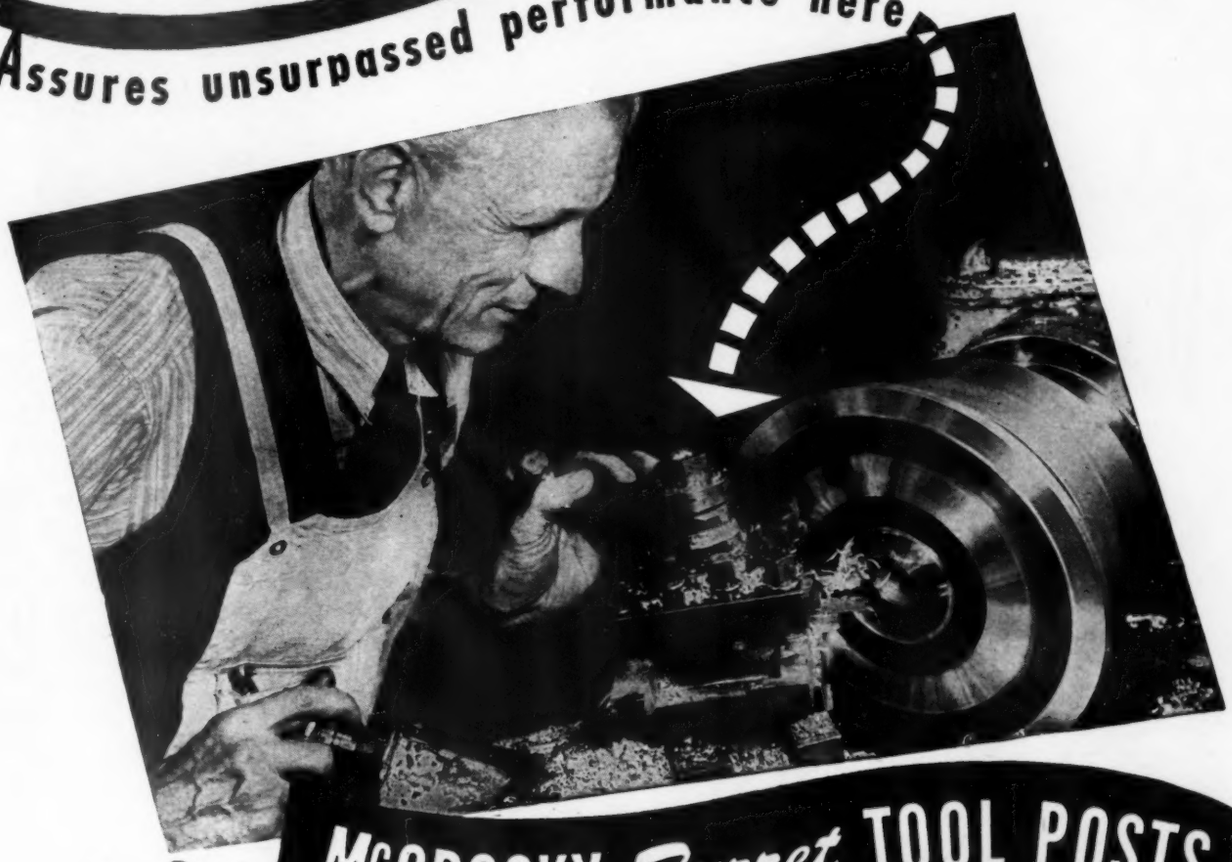
A live center, which has the same general dimensions as a standard dead center, is manufactured by the Samuel S. Gelber Co., 32 S. Jefferson St., Chicago 6, Ill. The spindle is of alloy tool steel, heat-treated to a hardness of 64 Rockwell and precision-ground. The shank is hardened and ground internally and externally. It has ball thrust bearings and radial roller bearings.

The bearings of this center turn on an anti-scoring concentrated lubricant developed to withstand pressures of more than 50,000 psi. A neoprene seal protects the center against damage by abrasive materials and serves to retain the lubricant for the life of the center, which is about 3,000 hr. operating under full-load capacity.

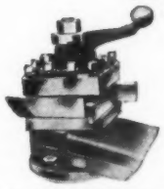


This time-proved construction here

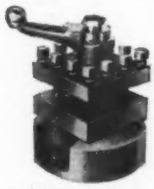
Assures unsurpassed performance here



McCROSKY *Turret* TOOL POSTS



Style "O" Turrets Mount in the T-slot.



Style "OL" Turrets Mount on the Bolt Circle of the Main Slide.

● Featuring a service-proved design conceived, perfected and available only from McCrosky, these tool posts give engine lathes the versatility of turret lathes. The indexing corrugations on the post and body, with their long shore line of contact, are finished to extremely close tolerance on specially built machines. This construction provides the extreme rigidity needed to withstand the thrust of the cut—minimizes wear—and assures easy, extremely accurate indexing of successive tools into cutting position, without stopping for tool changes.

McCrosky Turrets are used by leading concerns from coast to coast. Endorsed by all well known lathe manufacturers. Furnished in five styles including square and hexagon designs. Nine different sizes. Write for catalog.

McCROSKY TOOL CORPORATION
MEADVILLE, PA.

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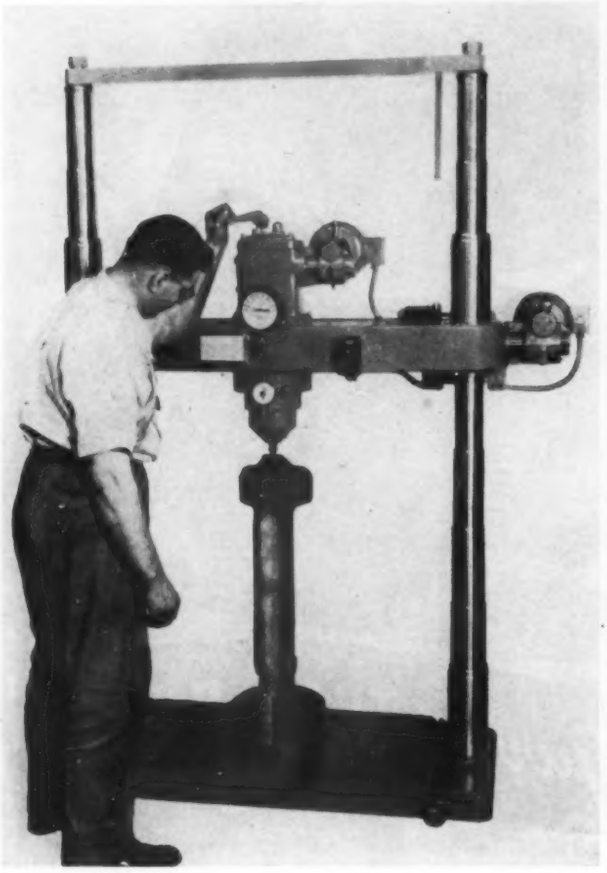
Jack-Lock MILLING CUTTERS — *Block Type* BORING BARS

Wizard CHUCKS AND COLLETS

Super Adjustable REAMERS — *Turret* TOOL POSTS

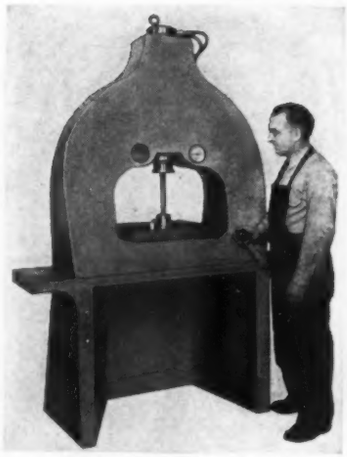
Steel City Brinell Tester Can Be Used on Assemblies

A machine designed for Brinell testing of heavy specimens has been developed by Steel City Testing Laboratory, 8843 Livernois Ave., Detroit 4, Mich. A hardened steel plate on the base of the machine, 3 in. from the floor, provides a solid foundation for supporting the specimen to be tested.



This machine, Type A4, can be set up in an assembly line or in any position to suit testing requirements.

The cross-head motor is operated by a reversible switch. Pressure upon the head is exerted hydraulically. The machine is equipped with either a standard Brinell microscope for reading the diameter of the impression or with a direct-reading attachment. It is furnished with overload protection, and is available in two sizes—3 ft. 8 in. between standards for testing specimens up to 51 in. height, and 22 in. between standards for testing specimens up to 24 in. height. The bed is equipped with levelling jacks.



Welded arch frame provides strength for 20 ton pressures and holds construction weight to a minimum

Northern Develops Portable 20-ton Hydraulic Press

A motor-driven portable hydraulic press of 20 tons capacity has been developed by Northern Tool & Machine Co., Box 68, Melrose Park, Ill. This press has an arch frame of fabricated steel-plate designed to divide the load between the two sides of the press to eliminate distortion. The press is suitable for broaching, forcing, bending, straightening, trying out dies and molds, forming, embossing, riveting, piercing, flanging, staking, upsetting, crimping, assembling, and clamping operations.

The arch is 14 in. high by 24 in. wide. The alloy-steel platen is 16 x 18 x 2 in. and is ground on both sides, drilled and tapped to accommodate setups within the capacity of the press. The power stroke speed is 90 in. per min. and can be opened from 0 to 12 in. Applied pressure can be controlled without retarding the ram speed.

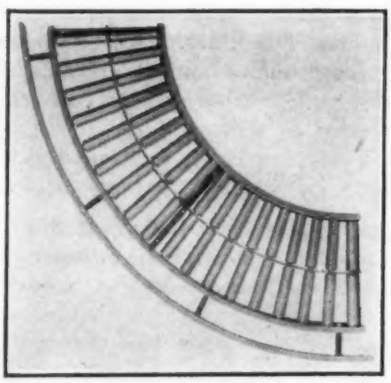
When the ram is fully extended, 12 in. of its length remains in the cylinder and serves as a pilot to insure vertical travel without side play. The return stroke travel of the ram is 120 in. per min. The ram is chrome-finished steel and has an outside diameter of 4 in. The end cap on the ram can be bored out to take a tool shank adapter. The pressure control valve can be set to provide adjustments from 1 to 20 tons.

The ram travel speed can be increased or decreased and the ram stopped at any point in its stroke or held on the work under pressure while the motor idles or is turned off. A gage, located at eye level, is calibrated in tons of pressure and psi.

Lyon Gravity Roller Conveyor Available in Section Units

Lyon Metal Products, Inc., Slarck St., Aurora, Ill., manufactures a line of gravity roller conveyors in these sizes: three straight sections, all 10 ft. long and in three widths, 12, 18 and 24 in.; three 90° curved sections, 12, 18 and 24 in. wide, and two trestles 18 and 24 in. wide.

Transportation on Lyon conveyors is by gravity; the rollers are not driven by power. A retainer channel under the top flange of the frame rails covers the ends of roller shafts and takes the place of cotter pins or hog-rings. By setting the rollers slightly above to level of the tops of the side rails, Lyon conveyors will accommodate packages that are wider than the conveyor section itself. All rollers are fitted with ball bearings engaged in the ends of the tube rollers by adapters.



Packages wider than the conveyor section can be rolled on the Lyons conveyor. Recessed bearings in the side retainer channels permit overhang

We'll lift the covers . . . IN MARCH

In this space, in March, we'll disclose three amazing new turning machines which Monarch has engineered expressly to meet rising production costs. However, if you'd like a quick "preview", we'll be glad to send you photographs and brief descriptions, immediately, with full details to follow the formal introduction. Write Dept. 201.

THE MONARCH MACHINE TOOL COMPANY · SIDNEY, OHIO

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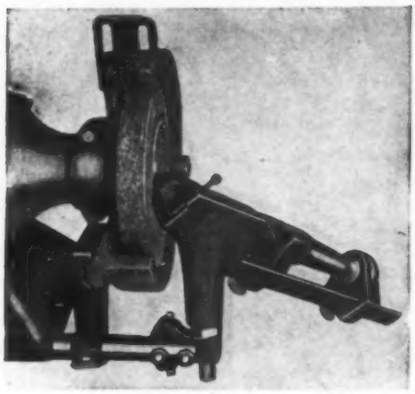
Monarch
TURNING MACHINES

Ind-L-Way Grinding Fixture Handles Drills 26 in. Long



Grinding guides insure accurate cutting characteristics to drill cutting lips

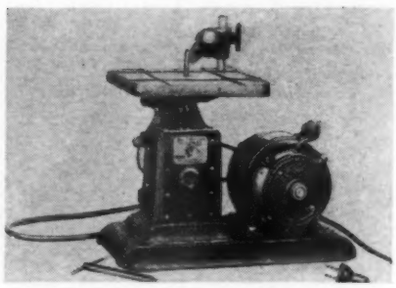
Industrial Mfg. Co., 1900 Euclid Ave., Cleveland, Ohio, is building Ind-L-Way drill-grinding fixtures in two models for sharpening drills from ¼ to 2⅞ in. in dia. and up to 26 in. in length. They are made especially for use with Black & Decker and Van Dorn bench and pedestal grinders, but can be applied to grinders of other makes which have the same dimensions and are of similar design.

Precision Die-filing Machine Actuated by Scotch-yoke Unit

All American Tool & Mfg. Co., 1014 W. Fullerton Ave., Chicago 14, Ill., has developed a precision die-filing machine for filing, honing, and sawing operations. A universal-joint clamping arrangement is employed to assure accurate vertical positioning of the file or other tool, even though the shank is warped or twisted. A file-setting square is supplied for aligning the file or other tool before clamping, and an overarm with a hardened-steel roller holds the file against the work.

The file is actuated by a scotch-yoke mechanism which runs in an oil bath, the height of which can be observed through a window in the housing. Locking thumbscrews on the outside of the housing facilitate quick, accurate adjustment of the vertical shaft bearings. A neoprene bellows seals the housing against oil seepage or the entrance of chips.

The tilting worktable is 8¼ by 8¼ in. The driving power is furnished by 1/6-hp. ac., 110-volt motor operating at a speed of 1725 rpm. The file has a stroke of ¾ in. and is driven at approximately 425 strokes per min. The universal-joint file clamp has a capacity of ⅛ to ¼ in. in. dia.

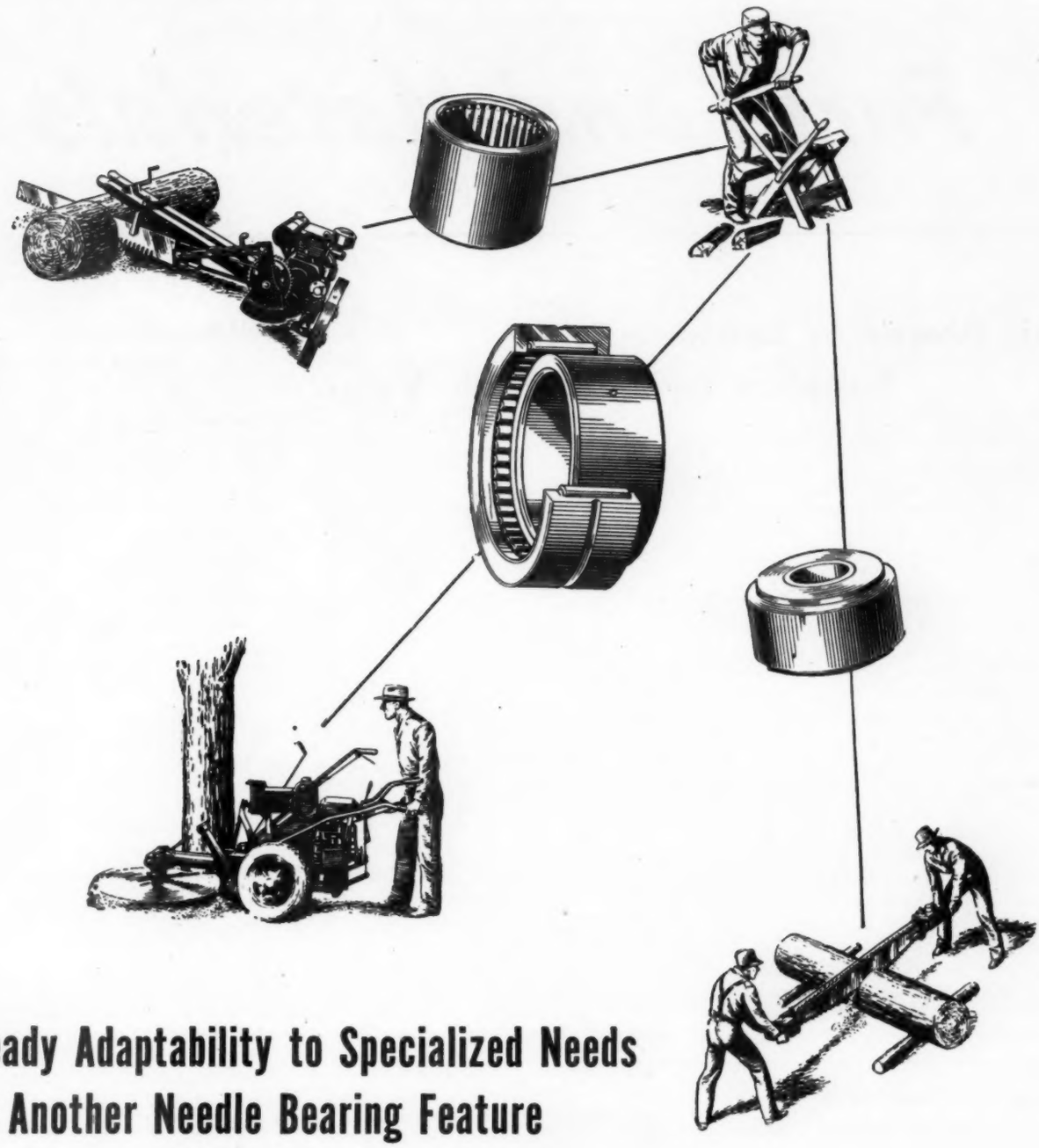


The file or other tool has a stroke of ¾ in. at approximately 425 strokes per minute. Universal-joint file clamp will take ⅛- to ¼-in. dia. shanks

Kindt-Collins Disk Grinder Grinds with Both Disk Faces

This 24-in. disk grinder is a product of the Kindt-Collins Co., 12651 Elmwood Ave., Cleveland 11, Ohio, and is adaptable to grinding metal, wood or plastics. Specific disk speeds required for grinding these materials are available. Features of the machine include a heavily ribbed, normalized and machined table which tilts 45° down and 25° up by worm and gear drive; both faces of the grinding disk can be used; circular and coreprint fixture has a capacity of 22 in. dia. and is wedge-shaped with 10° angle. The disk will accommodate both cloth and paper-back abrasives.

Two models of the Kindt-Collins grinder are available. Model A is furnished with its own dust-collection system and Model B is equipped with a 4-in. exhaust tube to be attached to a dust-collecting system



Ready Adaptability to Specialized Needs is Another Needle Bearing Feature

Major design changes are seldom necessary to gain all the advantages of anti-friction Needle Bearings. The Needle Bearing principle of a full-complement of small diameter needle rollers which gives increased load capacity and longer service life is widely applicable. And the Torrington line includes a type and size that is engineered to meet virtually every requirement of modern space-plus-weight-saving designs.

Thousands of outstandingly successful applications have been made where only slight modifications of existing designs and shop practice have enabled manufacturers to improve product efficiency —and often with resulting cost savings.

Let us give you more details on some of these applications in your own field. Full technical data and many applications are given in the Torrington Needle Bearing Catalog No. 32, available upon request. And our engineering staff will be glad to give every assistance in the layout of specific Needle Bearing applications designed to meet *your* requirements.

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TORRINGTON NEEDLE BEARINGS

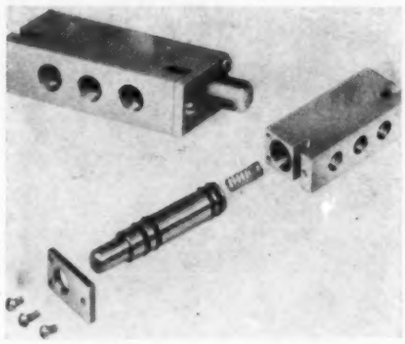
Parts and Materials

Air Power to Machine Tools Supplied by Modernair Valve

A Modernair three-way pilot valve designed for use in the application of controlled air power to machine tools is manufactured by Modern Products, Ltd., 952 S. Grand Ave., Los Angeles 15, Calif. This CRV pilot valve is designed to be used as a three-way valve, normally either open or closed, or as a two-way valve, normally open or closed.

Installation as a two-way pilot valve is compact, being 3¼ in. over-all with the piston fully extended. It can be operated either by hand, foot-treadle, or by a cam which can be part of a mechanism designed for a timed sequence.

The valve can be used to operate air cylinders, air motors, air controls, and single-acting cylinders. In addition to air operation, the valve can also be used in low-pressure hydraulic control and actuating systems. It is not possible for the plunger to come out of the housing during operation, but it can be removed to permit renewal of the packing rings without breaking any connections. It is fully balanced and operates freely under extreme variations in pressure. The ports are normally threaded to take ⅛-in. pipe fittings, but they can be machined to take other sizes.

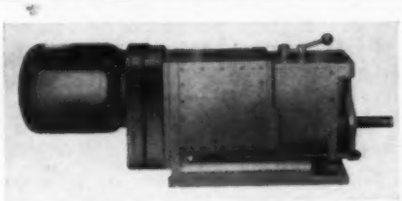


The Modernair three-way pilot valve is constructed to permit easy access for inspection and cleaning. Although the piston can be removed for maintenance, it cannot come out during operation

Hesco Drill Power Units Control Multiple Operations

A drilling, reaming, counterboring, and spot-facing unit has been developed by the Hole Engineering Service, 13722 Linwood Ave., Detroit 6, Mich. This unit, Hesco Model 100, is of completely mechanical construction and provides positive feed rates. It is compact in design, has a long feeding stroke, is adjustable to suit the operation and permits close grouping in multiple installations for unison or sequence operations.

The unit is available in either belt or motor-driven types and can be mounted at any angle. The motor is mounted in line with the head instead of above the unit, as in former models. The leadscrew feed provides control over the size of chip per flute. Variations in feed can be effected by changing leadscrews and leadscrew nuts. Quick advance and feed depth are adjustable from the front of the unit. Hand control is provided for setting the tools, and remote electrical control is furnished through built-in limit switches. The entire mechanism of the unit can be removed from the housing when servicing is necessary.



Hesco drill power units can be individually controlled to provide special functions

Shielded-arc Electrodes Handle Hard-facing Jobs

Two shielded-arc electrodes designed for hard-facing applications, are announced by The Lincoln Electric Co., Cleveland, Ohio. Abrasoweld AC is designed for building up straight carbon steel, low-alloy steel, or high-manganese steel, with a self-hardening deposit to resist severe abrasion, battering and impact. Although designed for operation on alternating current, it may be used with direct current. This electrode is a self- hardening type alloy which is semi-austenitic and abrasion resisting, and hardens rapidly under impact and abrasion. Moderate peening will increase hardness, as deposited, from 20-40 Rockwell C to over 50 Rockwell C. The weld metal maintains its toughness and develops its maximum hardness only at the surface where it is cold worked. Thus, beneath the surface remains a cushion of softer metal which eliminates checking and flaking. The deposit is more resistant to corrosion than high-maganese steel.

The Abrasoweld AC electrode is available in ⅛, 5/32, and 3/16 in. dia. and is furnished in 14-in. lengths.

Manganweld has been improved and is manufactured for reclaiming worn austenitic manganese steel parts contaninig 11 to 14% manganese. It is suited for use with dc. machines and may be used with ac. machines.

Generally recommended for flat work only, Manganweld A produces a flat bead and melts uniformly with minimum spatter. The weld deposit is air-toughening, remaining in austenitic state and retaining carbides in solution during air cooling. The deposited metal has a resistance to abrasion and impact that is equal to heat-treated cast manganese steel. Weld metal, as deposited, has a hardness 5 to 10 Rockwell C and cold-rocked, a hardness of 45 to 50 Rockwell C.

Manganweld A is recommended for resurfacing and building up applications of high-manganese steel and is sometimes applied only as top beads where an abrasion-resisting surface is required.

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FOR all products to be made by drawing, stamping and similar sheet metal operations, Revere sheet and strip of copper or brass offer maximum ease of fabrication. Not only are these metals naturally ductile, but they benefit further from the metallurgical skill which Revere has gained in 145 years of experience.

In composition, mechanical properties, grain size, dimensions and finish, you will find Revere metals highly uniform. They enable you to set up economical production methods and adhere to them. They can help you produce better products at faster production rates, with less scrap and fewer rejects.

Revere copper, brass and bronze lend themselves readily to the widest variety of finishing operations—polishing, lacquering, electro-plating and others. With these superior materials it is easy to make your products beautiful as well as serviceable.

That is why wise buyers place their orders with Revere for such mill products as—*Copper and Copper Alloys:* Sheet and Plate, Rolls and Strip, Rod and Bar, Tube and Pipe, Extruded Shapes, Forgings—*Aluminum Alloys:* Tubing, Extruded Shapes, Forgings—*Magnesium Alloys:* Sheet and Plate, Rod and Bar, Tubing, Extruded Shapes, Forgings—*Steel:* Electric Welded Steel Tube. We solicit your orders for these materials.

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Core Sand for Aluminum Aided by Uformite Binder

A synthetic resin binder that improves core sand used in casting such metals as aluminum and magnesium, Uformite 580, has been developed by Resinous Products & Chemical Co., 222 W. Washington Sq., Philadelphia 5, Pa. This binder is a urea-formaldehyde resin that requires no departure from standard preparational procedure, but the resultant resin-bonded sand core permits the casting of complicated members.

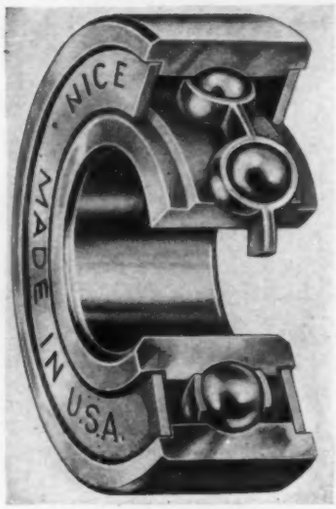
Uformite 580 is a dust-free, water-dispersible powder. It may be added directly to the conventional muller, kneader, or paddle-type mixers and uniformly dispersed throughout the sand without special precaution. Since this resin decomposes at the pouring temperatures of aluminum and magnesium much more rapidly than do drying oils, cores bonded with Uformite 580 break down readily during contraction of the metal on cooling and solidification, thereby minimizing the possibility of hot tears or metal strains as well as facilitating removal of the core through constricted openings during casting clean-up.

Its use in sand mixes relieves any tendency to stick to core boxes, conveyors and blower equipment. Core boxes may be used continuously without delaying production to clean interiors. Core sands mixed with this resin may be stored prior to baking as long as 4 to 5 hrs. without loss in tensile strength or surface hardness.

The low-temperature, short-bake properties of Uformite 580 (30 to 90 min. at 300-320 F.) do not cause volitalization of the protective agents added to core sands and hence assure greater uniformity. Cereals of the type used for imparting green strength to core sands are waterproofed by Uformite 580, retaining 40% of their strength when exposed to 100% humidity for 16 to 24 hr.

Alundum Abrasive Available For Wet-tumbling Operations

Norton Co., Worcester 6, Mass., has developed Alundum abrasive for use in wet-tumbling operations. It is available in four size groups: ¼ to ½ in., ½ to ¾ in., ¾ to 1 in., and 1 to 1½ in. dia., either untumbled or with the sharp corners rounded off by tumbling. The hardness of the abrasive provides continuous fast cutting action without glazing. This abrasive is used with water and a cleaner.



Precision Radial Ball Bearings Available With or Without Shields

Series 1600 in.-size precision radial ball bearings with solid inner and outer rings and ball retainer are manufactured by the Nice Ball Bearing Co., 30th and Hunting Park Ave., Philadelphia 40, Pa. These bearings have been designed for precision applications where close-tolerance units are required for medium loads and for maximum speeds of about 3,000 to 5,000 rpm.

The one-piece inner and outer races of these bearings have all surfaces ground to close tolerances. A ball retainer is incorporated to reduce ball friction and increase the range of allowable speeds. The 1600 series bearings are available with double shield, one shield, or without shields. All bearings can be furnished with or without grease packing, except the double-shielded units which are regularly grease-packed.

Wahlstrom Automatic Drill Chucks And Tappers Suit Power to Job

The Wahlstrom Tool Div. of the American Machine & Foundry Co., 5502 Second Ave., Brooklyn 20, N. Y., is manufacturing a line of fully automatic drill chucks and tapping attachments. The fully automatic tapper is designed for sensitive operation when power is applied for driving the largest-size tap within its range, as well as the smallest-size tap. In tapping, the power increases in proportion to the pressure exerted on the handle and the slightest upward movement of the drillpress handle instantly reverses the direction of rotation.

The positive safety driving clutch arrangement is designed to eliminate tool breakage. If the tap becomes clogged or if the tap comes in contact with the bottom of a blind hole, the drive is instantly thrown out of motion. The spindle, however, will continue to revolve. The reversible clutch forces the tap to revolve in a forward direction the instant it clears the work. This tapper is made in three size ranges—2-56 to 1/5 in., 5-40 to ½ in. and ⅜ to 1 in.

The fully automatic drill chucks are so designed that it is not necessary to stop the drillpress when changing tools. They require no keys or collets, a slight grip on the knurled sleeve serving to open the jaws and release the tool. Another tool can then be inserted and the sleeve released to permit the jaws to automatically grip the tool. These chucks are automatically self-centering, can be used for boring, milling, drilling, spot-drilling, and reaming.

The Model B drill chuck is designed to hold straight-shank drills, and can be used for tapping by grinding three flats on the tap shank. It is adapted for tapping nuts, and is available in three size ranges—15/64 to ½ in. with either No. 1 or No. 2 Morse taper shank; ⅜ to ¾ in. with either No. 2, 3, or 4 Morse taper shank; and 17/32 to 1 in. with either No. 3 or No. 4 Morse taper shank.

The Model A chuck is made in two size ranges—1/64 to ⅜ in., with No. 1 or No. 2 Morse taper shank, and 1/32 to ½ in. with No. 1, 2 or 3 Morse taper shank.

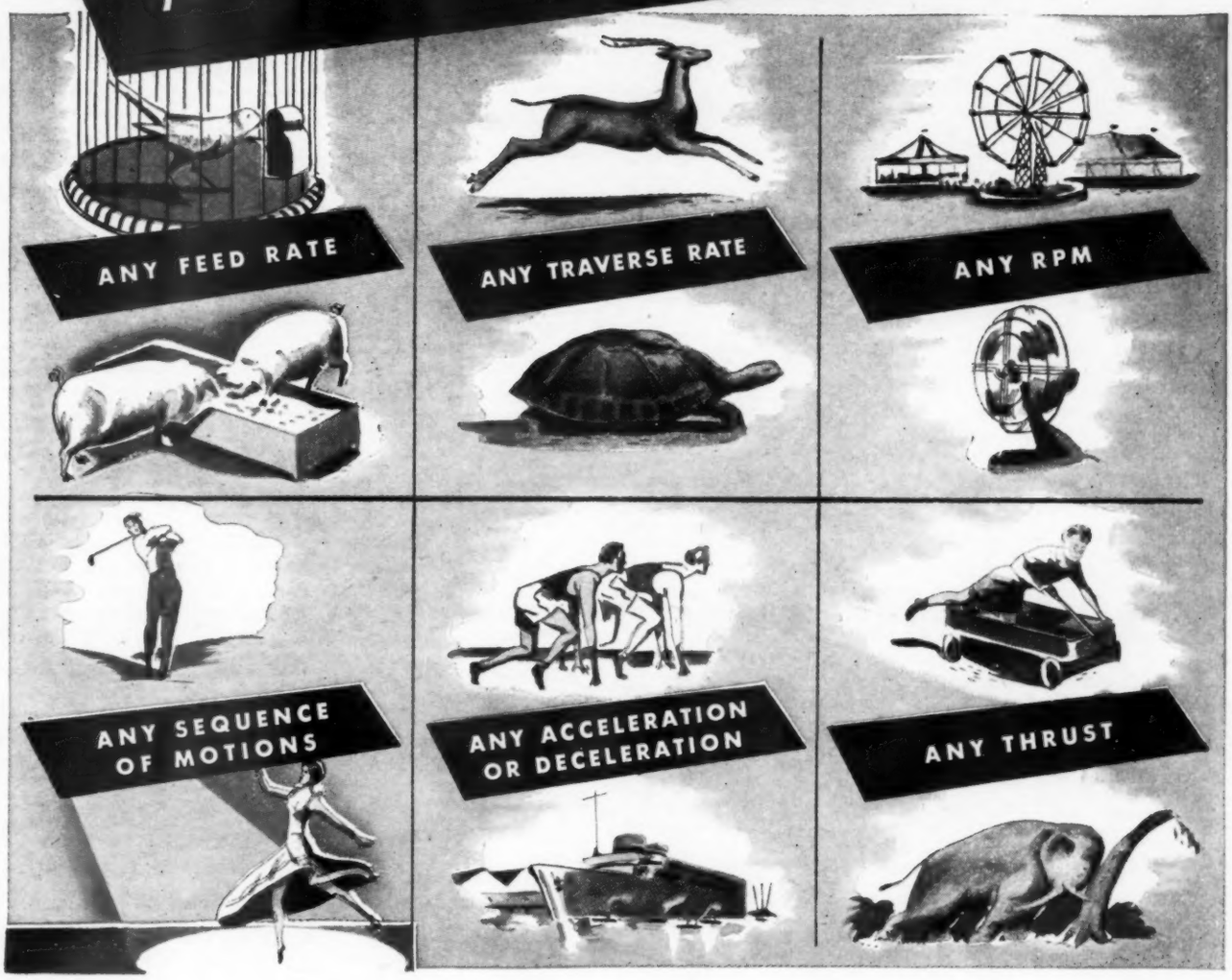
The Model C drill shank is designed especially for holding taper-shank tools. It will hold tools with No. 1, 2, or 3 Morse taper shanks, and can be fitted with either a No. 3 or No. 4 Morse taper shank. This chuck will hold tools with or without tangs.

Carboloy Plug Gage Bushings Rough-Finished for Grinding

The Carboloy Co., Inc., 11147 E. Eight Mile, Detroit 32, Mich., announces 40 standard sizes of Carboloy go and no-go plug gage bushings in rough form ready for finishing. Bushings range in size from a finished gage diameter of 0.366-0.406 in. to a finished gage diameter of 1.501-1.531 in.

Carboloy rough ring-gage bushings for gages ranging from 0.059 in. to 1.510 in. dia. are also available. The outside diameter of these bushings range from ⅜ to 1 15/16 in. All gage bushings are made of Grade 44A Carboloy.

VERSATILITY that *Exactly* meets your needs in MACHINE TOOLS



Machine tool design is set free from a host of limitations when Vickers Hydraulic Controls and Drives are used. With no difficulty at all, the designer has an extremely wide choice of feed rates, traverse rates, RPM, sequence of motions, accelerations or decelerations, and thrusts.

Practically any machine tool can be designed *and built* to do *exactly* the required job by using Vickers Hydromotive Controls in one of the infinite number of combinations provided by more than 5000 standard Vickers Units.

In addition, positive overload limitations can be built into any machine—definite safety factors provided for both the machine and the operator.

Only Vickers Hydraulic Controls provide *all* the advantages of hydraulic operation—including exceptional compactness and reliability.

Let Vickers Application Engineers consult with you on your new designs.

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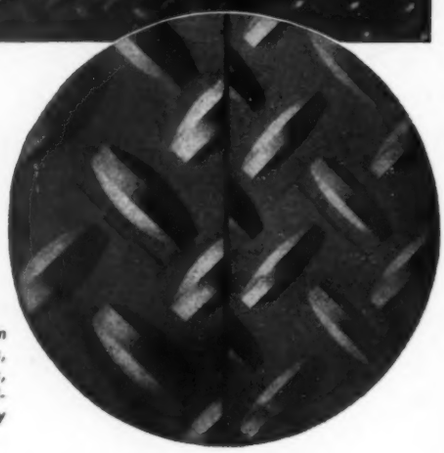
VICKERS Hydraulic CONTROLS and DRIVES

ENGINEERS AND BUILDERS OF OIL HYDRAULIC EQUIPMENT SINCE 1921

In stock at eleven Ryerson plants are the two pattern sizes shown at the right.



Projections are 1¼" long on the large pattern and 1" long on the small.

Other products in stock include: bars, structurals, plates, sheets, tubing, alloys, Allegheny Stainless, etc.

INLAND 4-WAY FLOOR PLATE

SAFE, SURE Footing

About 150,000 men and women are injured every year by slipping and falling accidents in industry! But you can guard against these accidents in your plant. With Inland 4-Way Floor Plate on floors, stairways, loading platforms, walkways, etc. you get very safe traction and long wear. When you order from nearby Ryerson stocks, plates are delivered quickly, accurately cut and ready for installation.

Wherever sure footing is important, Inland 4-Way Floor Plate should be used. Projections, covering more than one third of the area, center on one another at right angles, giving 4-way protection against slipping—forward, backward, to the left or right. Because Inland floor plate is made of tough rolled steel, it is structurally strong and long wearing.

Ryerson has two pattern sizes and many thicknesses in stock, plus facilities for cutting to square or irregular shape. For quick delivery, contact the plant nearest you. *Inland 4-Way Floor Plate Catalog sent on request.*

Joseph T. Ryerson & Son, Inc. Steel-Service Plants at: Chicago, Milwaukee, Detroit, St. Louis, Cincinnati, Cleveland, Pittsburgh, Philadelphia, Buffalo, New York, Boston.

RYERSON

ROUND TABLE DISCUSSION

PROFIT TAKER OR MAKER?

I would like to emphasize one point in connection with your recent Round Table on this subject. The arrival of new machinery or equipment in a shop always arouses a great deal of enthusiasm among the workers. Watch how they crowd around the machine wondering what this handle or that handle is for and kid one another to see who will be the first to use it. If it is a toolroom machine, the toolmakers will use any pretext to use it on their next job. Keep an eye on this machine. As the supervisor hands out the jobs, notice where the workman goes to do his job. Does he use the five-year old, the ten-year old or the new machine? Invariably it is the new machine. Why? It is easier to operate and is more adaptable for a variety of work. It takes some of the strain from the man and enables him to do more work in the same time, thereby increasing the profit percentage.

If it is a production machine, the supervisor will have a job for it in order to compare it with the older machines. Invariably the increased production of the new machine over the older machines brings from the supervisor a request for more new machinery to replace the older models which cannot get out the work as fast as the newer models. Increased production means an increase in profit percentage.

Behind all this is the forward thinking and farsighted management who are not as we would say in a rut like the "Ed" of the Round Table but are ever striving to keep their company in the lead in the search for new business. This can only be done with a well-equipped shop—and you don't have a well-equipped shop unless the owner sees an increase in his profits from it.

John P. J. Harrington
Fall River, Mass.

SCHEDULED MAINTENANCE

Machine tools, vehicles, artillery, sewing machines, instruments and a thousand other articles are all in the same class when it comes to maintenance, and all face problems similar to those described in the recent Round Table on this subject.

SHEFFIELD Crush-Dressed GRINDING IS FASTER

IVANHOE 1634

APT PARTS

ZAGAR TOOL, INC.
22000 LAKELAND BOULEVARD · CLEVELAND 17, OHIO

October 1, 1945

Mr. C. J. Linxweiler, Mgr.
Machine Tool Distribution
The Sheffield Corp.
Dayton 1, Ohio

Dear Mr. Linxweiler:

Yes, of course, you have our permission to use the photograph sent you and we are very pleased to advise that our Sheffield Precision Thread and Form Grinder has been in constant use for well over a year on production of Class 3 ground threads for the aircraft industry. Production with the multiform crush dressed wheel is many times faster than with conventional single point grinding, even on the hardest of materials.

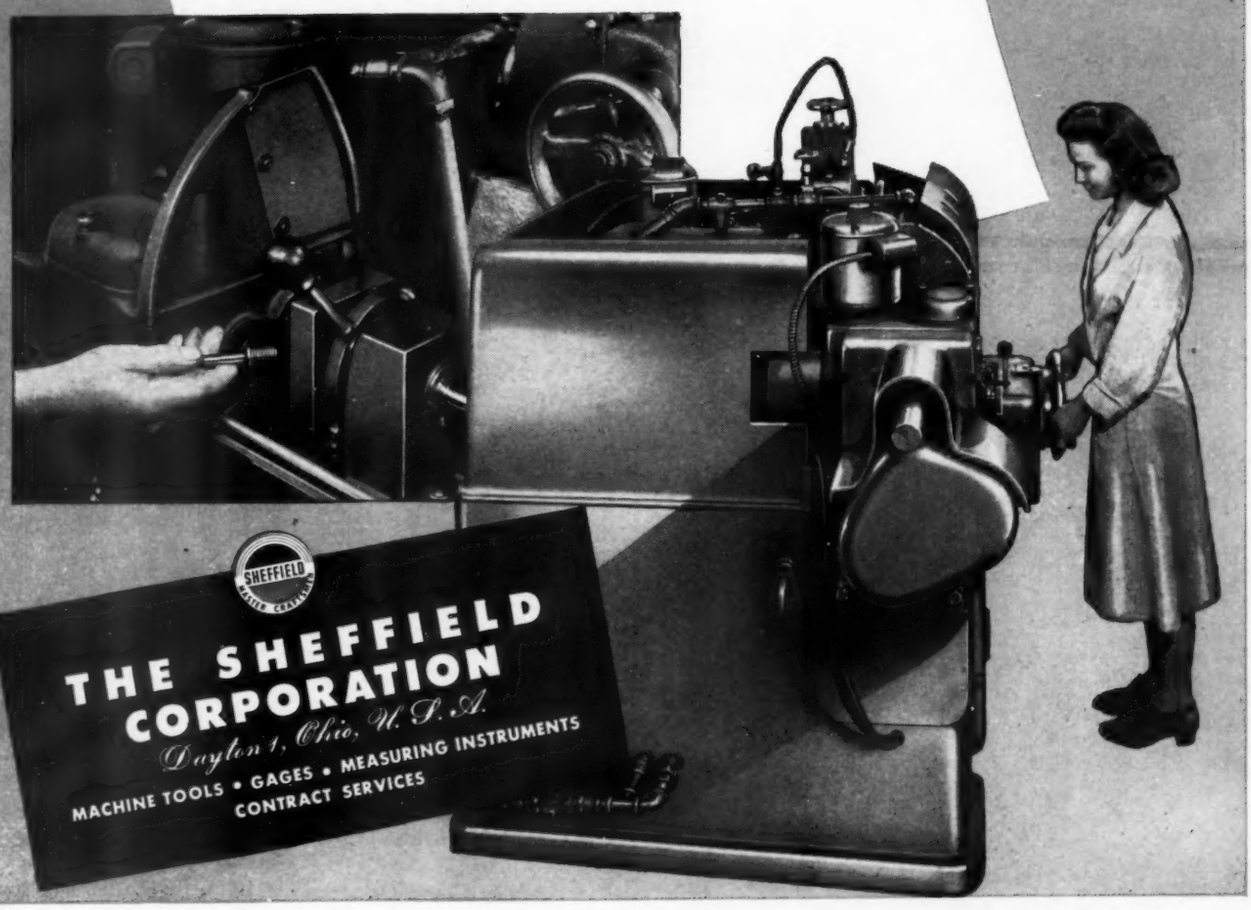
If we can be of any further assistance, please advise.

Yours very truly,

ZAGAR TOOL, INC.

J Nadon

F. Nadon
Sales Department



SHEFFIELD PRECISION CRAFTSMANSHIP

THE SHEFFIELD CORPORATION

Dayton 1, Ohio, U. S. A.

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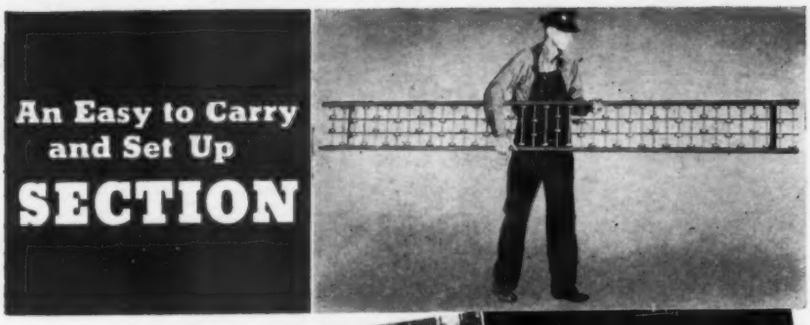
CONTRACT SERVICES



Whatever Your Need in Conveying Equipment, Standard *offers* any one or all three

WHATEVER you have to handle — packages, parts, units,—from receiving of raw material through manufacturing or processing to storage or shipping, Standard equipment can speed operations — save time and cost.

An 8 to 10 ft. section of Standard Wheel Conveyor expedites "spot" handling — a Standard Handibelt or Handipiler portable unit stacks and piles packages easily and quickly to ceiling height or loads and unloads cars and trucks with ease and dispatch — a Standard system of power or gravity conveyors accelerates handling — cuts the cost — at every step in manufacturing.

The range and versatility of Standard Conveyors have been developed in more than 40 years of service to business and industry.

Write for valuable reference book "Conveyors by Standard" Catalog No. AM-26

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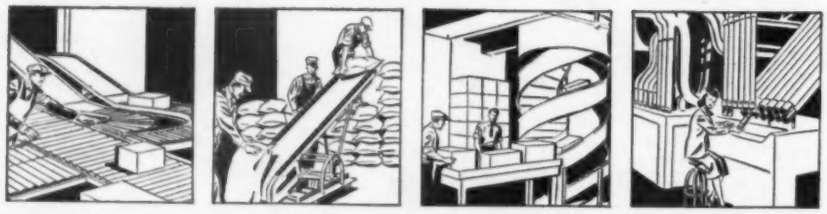

ROLLER · BELT · SLAT · PUSHBAR CONVEYORS · PORTABLE CONVEYORS AND PILERS · SPIRAL CHUTES · PNEUMATIC TUBE SYSTEMS

What about war? We all have very fresh memories on this subject, and strangely enough, our success in defeating the enemy has in no small way been due to maintenance. Maintenance of our fighting equipment has paid handsome dividends in keeping our advancing armies going in the right direction. Maintenance of the equipment which manufactured our fighting stores made possible the victories which are now ours. Whether these achievements were secured by scheduled maintenance or not I can't say, but I do insist that scheduled maintenance has proved its worth over and over again. None of us expect a machine tool, instrument, a sewing machine or a pair of boots for that matter to last forever, but we do wish for the full life expectancy of any article which we buy or use, whether it be our own property or our employer's.

Let's take the case of the Canadian Army which, like other armies, grew up in a great hurry. At the commencement of the war, Canada had very little modern fighting equipment. After a comparatively short period, new equipment began to roll off the assembly floors and before long reached the users. Maintenance instructions unfortunately did not roll out at the same speed, with the result that equipment did break down and *did not* in many instances, perform as it should have done. This situation at one stage threatened to become a serious problem but was caught in the nick of time by a group of highly trained specialists formed to overcome the difficulty. These men proved adept at detecting maintenance hazards.

Scheduled maintenance was the keynote in this group's efforts. Vehicles, tanks, guns, mountings, instruments and dozens of other fighting stores had to be dealt with, and dealt with they were. It was soon found that servicing of technical stores could not be done in a haphazard way. A systematic scheduled statement of maintenance was found essential. Unlike industry, the Canadian Army has no gang of maintenance men for the specific purpose of greasing and oiling. They have their maintenance men, yes! but they are primarily engaged in modification, repair and overhaul of equipment. The man who uses the equipment is charged with the responsibility of maintaining it in good condition. Anything beyond the scope of the operator is reported, and that is where the Army maintenance men come into the picture.

A statement of the maintenance and intervals at which it is to be carried out by the operator or user has been

REMOVES .014" IN *One Pass*

SUNOCO EMULSIFYING CUTTING OIL...

Provides Outstanding Cooling, High Accuracy, Fine Finish

In every shop, a careful study of every factor influencing cutting or grinding efficiency will pay important dividends.

Here, for example, is a typical case in which the use of Sunoco Emulsifying Cutting Oil on a grinding-operation pays-off in fast production, high finish, great accuracy.

Operation: A short-traverse job, grinding cast-iron sleeve.

Machine: Cincinnati 10 x 36 Plain Hydraulic Grinding-Machine.

Material: Cast Iron.

Stock Removal: .014 inch.

Lubricant: 1 part Sunoco to 40 parts Water.

Sunoco makes possible faster metal-removal without increasing wheel-wear. Sunoco rapidly dissipates heat and helps prevent the loading or burning of wheels. Even at high surface-speeds, close tolerances and mirror-finishes are easily maintained.

For tough problems, involving petroleum products, for smooth cutting and grinding schedules, call the Sun Cutting Oil Engineer near you, today

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INDUSTRIAL PRODUCTS

MEASURING in MILLIONTHS

. . . for three generations

IN SWEDEN, before the turn of the century, Hjalmar Ellstrom, father of Elmer Ellstrom, the present head of the Dearborn Gage Company, built the first known gage blocks to accuracies of millionths of an inch.

That same Ellstrom was the production genius of the first company ever to sell master gage blocks commercially.

Today, his son and grandsons are carrying on in his footsteps by making gage blocks for industry throughout the world. In fact, they were the only ones to make a major improvement on Hjalmar Ellstrom's original gage block by successfully chromium plating the gaging surfaces of their blocks to increase their wearing qualities.

Yes, in three generations, craftsmanship in millionths of an inch has become a tradition with the Ellstrom family. This has prompted the writing of a booklet entitled, "The Saga of Ellstrom". It tells the complete story of the development of the gage block. Your copy will be sent you upon request, just write the Dearborn Gage Company, 22038 Beech Street, Dearborn, Michigan.

HJALMAR ELLSTROM

ELMER ELLSTROM

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Ellstrom

3 GENERATIONS of GAGE MAKERS

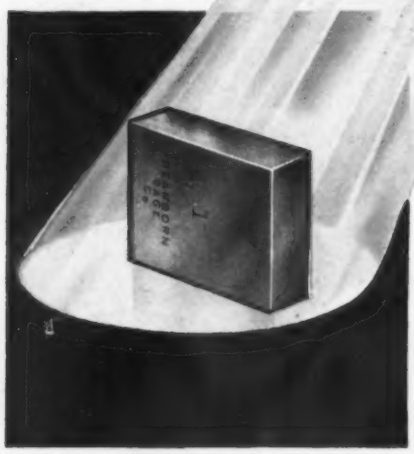
ELMER ELLSTROM II

RALPH ELLSTROM

DEARBORN GAGE CO.

22038 Beech St. Dearborn, Michigan

Originators of Chromium Plated Gage Blocks



This Ellstrom tool makers set with chromium plated gaging surfaces contains 6 blocks in .0625, .125, .250, .375, .500 and 1" sizes available in standard accuracies. Prices sent on request.

prepared for the majority of technical stores in the form of Compulsory Maintenance Schedules. The use of these schedules has considerably reduced work loads on maintenance workshops and has consequently prolonged the life of many costly stores. The value of continued efficiency of a weapon, machine tool, instrument or vehicle cannot be overestimated by the user, most especially when its need may turn a tide. This is where scheduled maintenance has, and still does, justify itself in practically all applications.

L. A. Burke
Maintenance Engrg. Specialist
Dept. of National Defense, Canada

WHERE SHOULD USED TOOLS GO?

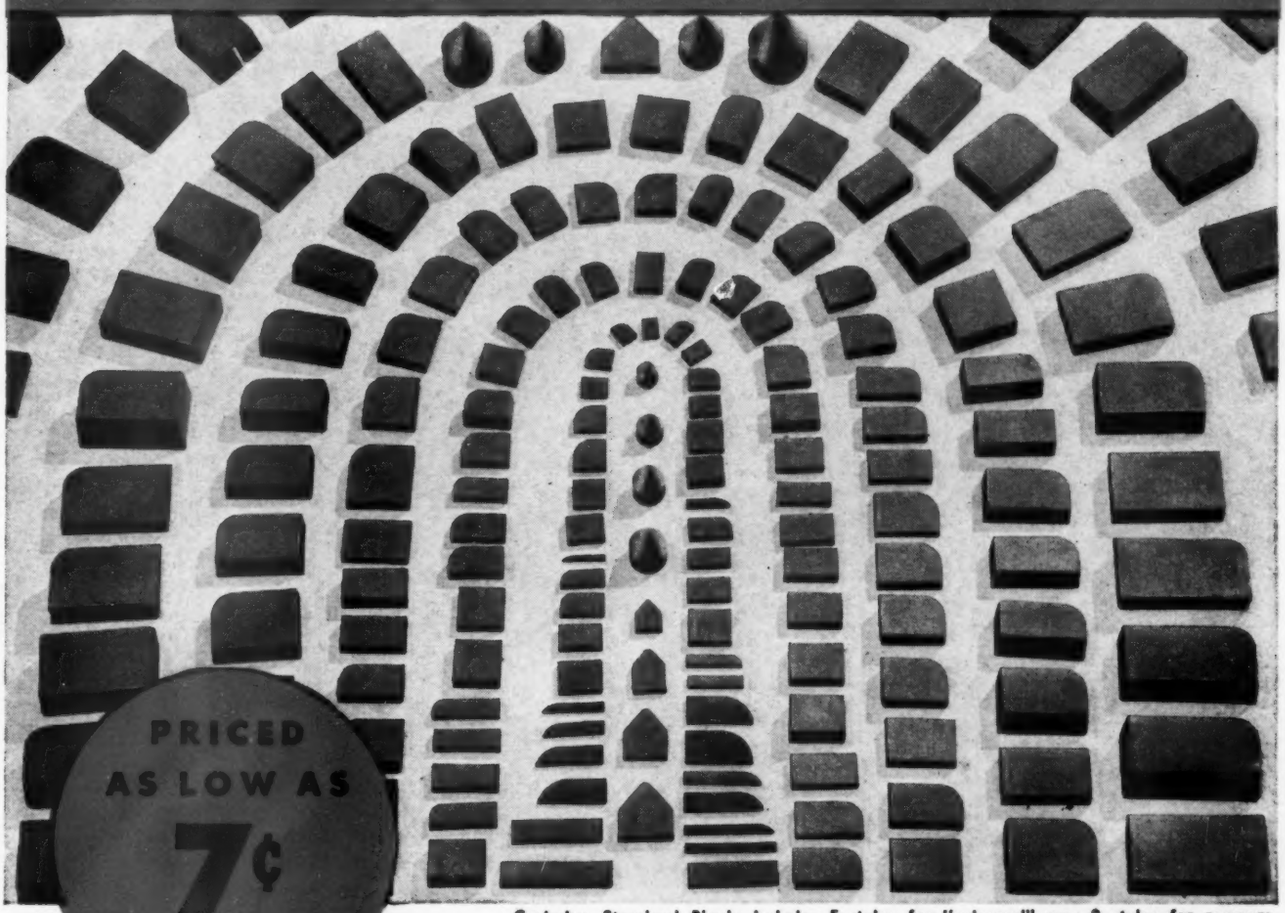
A second-hand machine is as good as a new one only when it will do the work accurately, quickly and with a minimum of time out for repair and adjustment. A machine should be judged on what it produces and at what cost if it is to be considered a tool of production.

The important factor in the choice of an old machine is: Can it earn its keep and return a profit to the owner? If it can, it is possible it might be retained. However, other factors might be considered more important than age or condition, the most important being capacity. Capacity is built into the machine in the builder's shop, and any time that capacity is not up to the required standard the machine is only taking up valuable floor space.

Machines built before the war were designed to use cutting tools of high-speed steel. During the war, cemented carbides came into use at a greater rate than would have been thought possible if peacetime conditions had prevailed. Old machines do not have the capacity required to make full use of these new tools. Feeds and speeds have been stepped up. Better finish and closer tolerances are expected and will have to be met if competition is not to steal the customers. This means the machine builder has to design his machines with more power and speed.

Therefore, the criterion for the choice of an old machine should be ability to do the work required. Like the farmer who finds he cannot do the work on his land with a good horse and so buys a tractor, the machine-shop owner must put his good old machines aside and replace them with new machines of greater capac-

For lowest cost–SPECIFY THESE "STANDARDS"



Carboloy Standard Blanks include: 5 styles for "universal" use; 3 styles for reamers, scrapers (and centers)—in all the commonly used sizes and grades for machining all metals.

For 60-80% of all your carbide machining needs, you'll find Standard Carboloy Blanks tops in economy—flexibility—convenience. Here's why they rate so high in these important features—

1. *Low Price:* More than 50% of all general purpose Standard Carboloy Blanks range in price from 60 cents down to as little as 7 cents each!

2. *"Universal" Application:* Standard Blanks are designed for broad use throughout your range of machining requirements. With only a small, low-cost inventory in your crib, you're still prepared for quick tool-up on the average job.

3. *Stocked for Prompt Delivery:* Standard Blanks are stocked for quick delivery by Carboloy Company, and authorized distributors in 45 cities, coast to coast. Packaged in standard quantities, for your convenience.

Available in a wide range of sizes; in grades for cutting steel, cast-iron, non-ferrous metals and non-metallics. Write for FREE catalog GT-175R.

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Tough

CAPEWELL
HACK SAW BLADES
MAKE RECORDS
ON THE TOUGH JOBS

Are you wrestling with production sawing problems - - especially on hard-to-cut alloy steels. Then ask your mill supply house to send you a Capewell man to study your problem.

THE CAPEWELL MANUFACTURING CO.
HARTFORD, 2, CONN.

ity if he expects to stay in the running.

If the toolroom needs a new lathe for any reason, it is not good business to hold back this lathe because production also needs a new lathe. The toolroom should have its own budget to operate on. It should also be able to show at the end of the year that it has earned enough money to warrant the purchase of a new lathe. If the toolroom is expanding, an appropriation should be set up to cover the expansion program. If money is not available to operate on a departmental basis then best judgment must be used as to where to spot the new machines which can be afforded. We can do this simply by placing the new equipment in the department where it will do the most good.

Charles E. Livingway
Detroit, Mich.

COMPANY USED TOOLS

My opinion on the Round Table on this subject in recent issue, based on 45 years of experience in various machine shops and toolrooms, is that you cannot perform precision work profitably on worn machines. Therefore, if the tool is badly worn, it should be junked; if capable of repair and tooling for a production job, it should be sent to the production department. The average operator on a production job is today merely working from whistle to whistle, doing a set day's work. It makes little difference to him what kind of machine he operates, as long as he gets in a day's time with as little exertion as possible of body or brain.

If kept in the toolroom, repairs would probably be so extensive the cost would be excessive, and even after repair, the machine would probably be slow, inaccurate, and general ly disgusting to an experienced toolmaker who takes a real craftsman's pride in the accuracy and speed with which he works.

J. G. Hoffner
Anderson, Ind.

CASH AWARDS NECESSARY

The Round Table question "Pay For Suggestions?" recalls that thousands of dollars have been paid in the last few years as awards for suggestions. It is safe to say that without the attraction of possibly receiving a cash award, many of these suggestions would not have been submitted. When persons receiving awards are given the credit due them, they usually respond with other worthy ideas —a factor which should not be overlooked.

A common practice is to post the names of those submitting acceptable suggestions in a conspicuous place in the plant, thereby giving them favorable publicity. A little note of acknowledgement here will go a long way in creating good will toward the suggestors, and a possible incentive to those not participating to take part in the plan. Many persons are interested mainly in monetary gains, and to them a suggestion plan without cash awards is not worth their time; therefore, to attract these employees, who also may have some very brilliant ideas, cash awards are a necessity.

Until someone comes along with a better idea, management might as well realize that good ideas are worth money.

Robert T. Knotek
Cleveland, Ohio

DON'T HAMPER FOREMEN

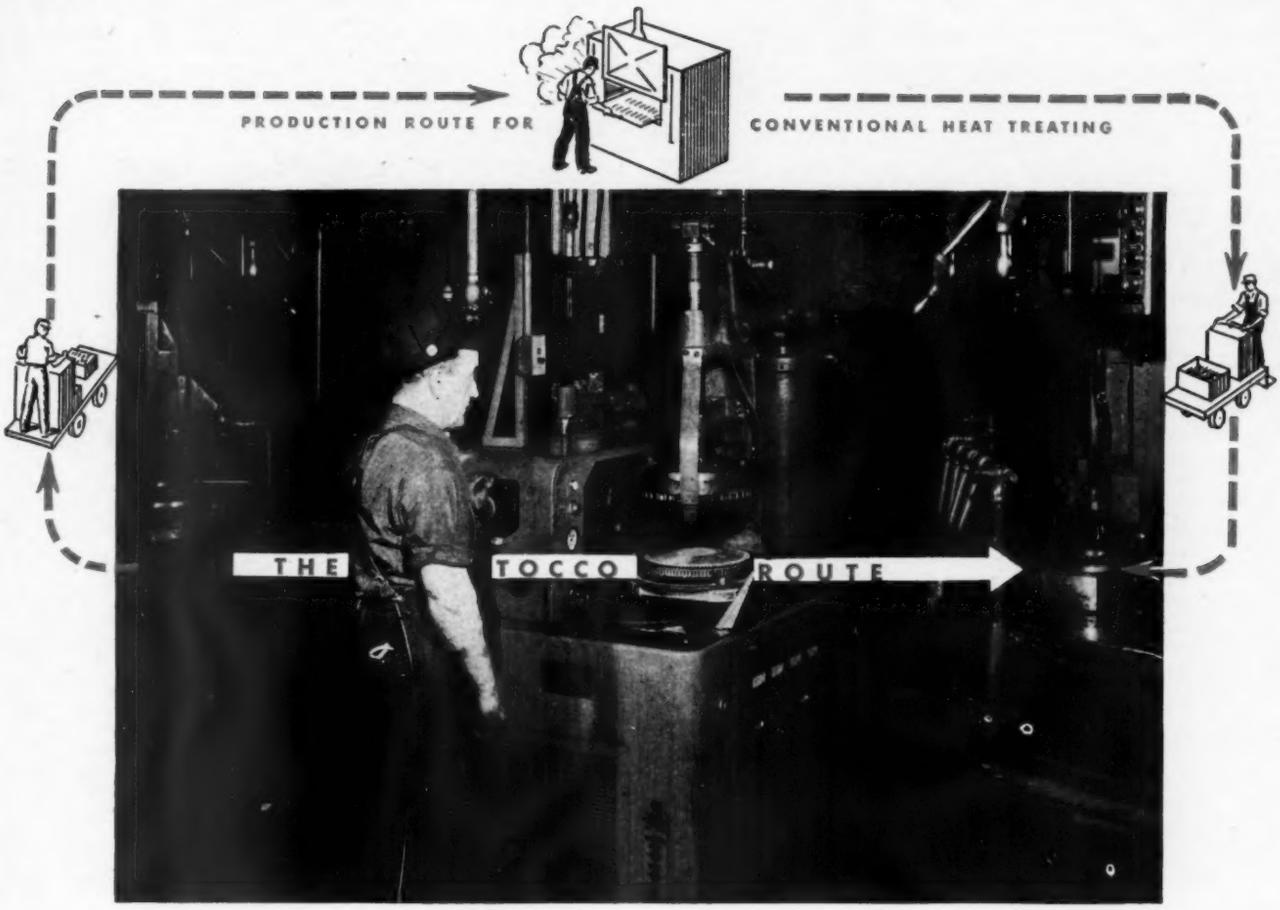
The Round Table discussion on "Mouthpiece or Manager?" raises a series of questions in my mind. For example: When is a foreman not a foreman? Should he have complete rights in his department? How about the so-called "service" departments and the tendency in some plants to make the foreman just a "pusher" or gang leader for labor? What should a foreman's job be?

It is true that some plants regard a foreman as a potential Simon Legree: Get the work out—or else! But this is a shortsighted policy and one which is productive of much discontent. A worker does not mind being led; he does not want to be driven.

Naturally, production must be maintained, since both worker and employer benefit. And it is the foreman's place to see that such production continues smoothly. That is why a foreman is chosen. He is (or should be, because of his wider knowledge) a leader of his men, one who may be appealed to when doubts arise about any particular job.

As a foreman, he should be the highest authority in his department, able to reward as well as administer punishment. But since such authority is sometimes abused, there should be a higher source to which to appeal. Nevertheless, the foreman should be permitted to run his department as he thinks best, provided it is to the best interests of management.

Milton E. Sussman
Dunellen, N. J.



WHY ISOLATE YOUR *HEAT TREATING?*

WILLYS-OVERLAND MOTORS, Inc., reports this time-saving idea in the manufacture of flywheel ring gear assemblies for the famous Jeep:

A compact, cool, clean TOCCO machine—used for shrink-fitting — is spotted between two automatic lathes which perform related operations. Conventional heating practice . . . cumbersome, hot and dirty . . . would have required isolation of the shrink-fitting operation and a costly production detour. The handy TOCCO set-up allows this efficient procedure:

The man shown in the picture machines one side of cast iron flywheel in machine at left . . . places it and ring gear in TOCCO work fixture . . . presses TOCCO start button.

The TOCCO machine automatically heats ring gear to 400°F. in 12 seconds, expanding its 12" diameter .025" . . . lowers ring gear and presses it on flywheel . . . quenches ring gear, cooling and shrink-fitting it to flywheel.

A second man removes the assembly from TOCCO and machines other side of flywheel in machine at right.

Since TOCCO almost operates itself, only two men are required for this three-machine set-up.

Find out how TOCCO can solve many of your production problems. The book, "Results with TOCCO," will be sent free on request.

THE OHIO CRANKSHAFT COMPANY • CLEVELAND 1, OHIO

TOCCO

INDUCTION

HARDENING . . BRAZING

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Here's one way

McCASKEY TOOL CRIB CONTROL

will help you

REDUCE MANUFACTURING COSTS

The McCaskey System definitely records employees' responsibility for tools. No time-wasting disputes occur when tools are turned in or employees quit. As a result, the loss or theft of tools is practically eliminated.

Here's a case in point, taken from the statement of a well-known plant using McCaskey Control:

Under the old system, the cost of the cutting tools, gages, micrometers and other tools that were lost, strayed or stolen each year amounted to a considerable sum. Under the present system (McCaskey), the loss of a tool is very rare indeed.

The crib attendant knows where each tool is and can locate it instantly. Thus the arguments that wasted time and ruined otherwise good dispositions in days of yore have been completely eliminated.

This is only one of numerous advantages of McCaskey Tool Crib Control that effect substantial reductions in tool expense and contribute to lower over-all production costs.

Let us have a representative explain how McCaskey Tool Control will pay for itself in a few weeks . . . or send you factual reports on McCaskey savings in several well-known plants.

THE McCASKEY REGISTER COMPANY, ALLIANCE, OHIO

McCaskey Systems Ltd., Galt, Ontario, Canada — *The McCaskey Register Co., Watford, England*

McCASKEY INDUSTRIAL CONTROLS

PRODUCTION • INVENTORY • MAINTENANCE • TOOLS • COSTS • PAYROLL

Clubs and bag, courtesy
A. G. Spalding & Brothers, Inc.

WHICH CLUB OFF THE TEE?

DRIVER, BRASSIE, SPOON . . . or perhaps even a "5" iron, you choose your club according to the shot you wish to make.

Today it's much the same with aluminum: You choose the alloy, temper and form best suited to each specific job.

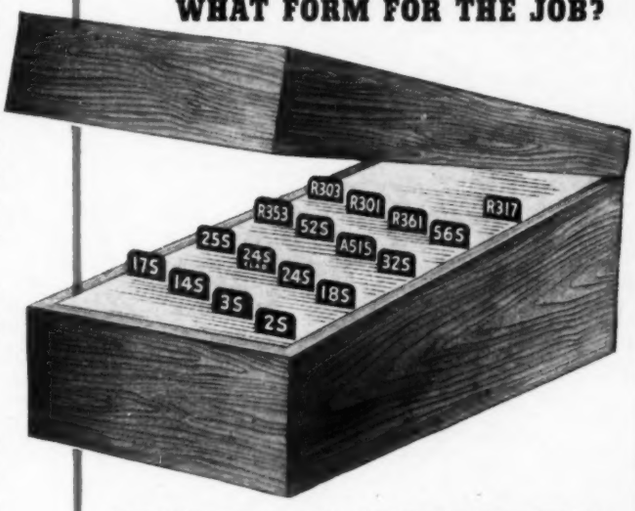
For example, to manufacturers of certain products, high unit-strength is a vital factor. To others, lightness may be even more important. Still others may require superior adaptability to forming or corrosion-resistance; or a combination of qualities.

Use of the *right* aluminum alloy means a better, more serviceable product at lower cost. Reynolds will help you specify it.

Consider Aluminum . . . Consult Reynolds

Whatever your interest, Reynolds technicians are ready to cooperate with your engineers. Offices in principal cities. Phone nearest office or write Reynolds Metals Company, Aluminum Division, 2523 So. Third St., Louisville 1, Ky.

WHAT ALLOY? WHAT TEMPER? WHAT FORM FOR THE JOB?



Match the alloy to the job, obtaining the temper needed in the form best adapted to your production. Result: a better product at lower cost.

REYNOLDS METALS

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REYNOLDS ALUMINUM

The Great New Source of

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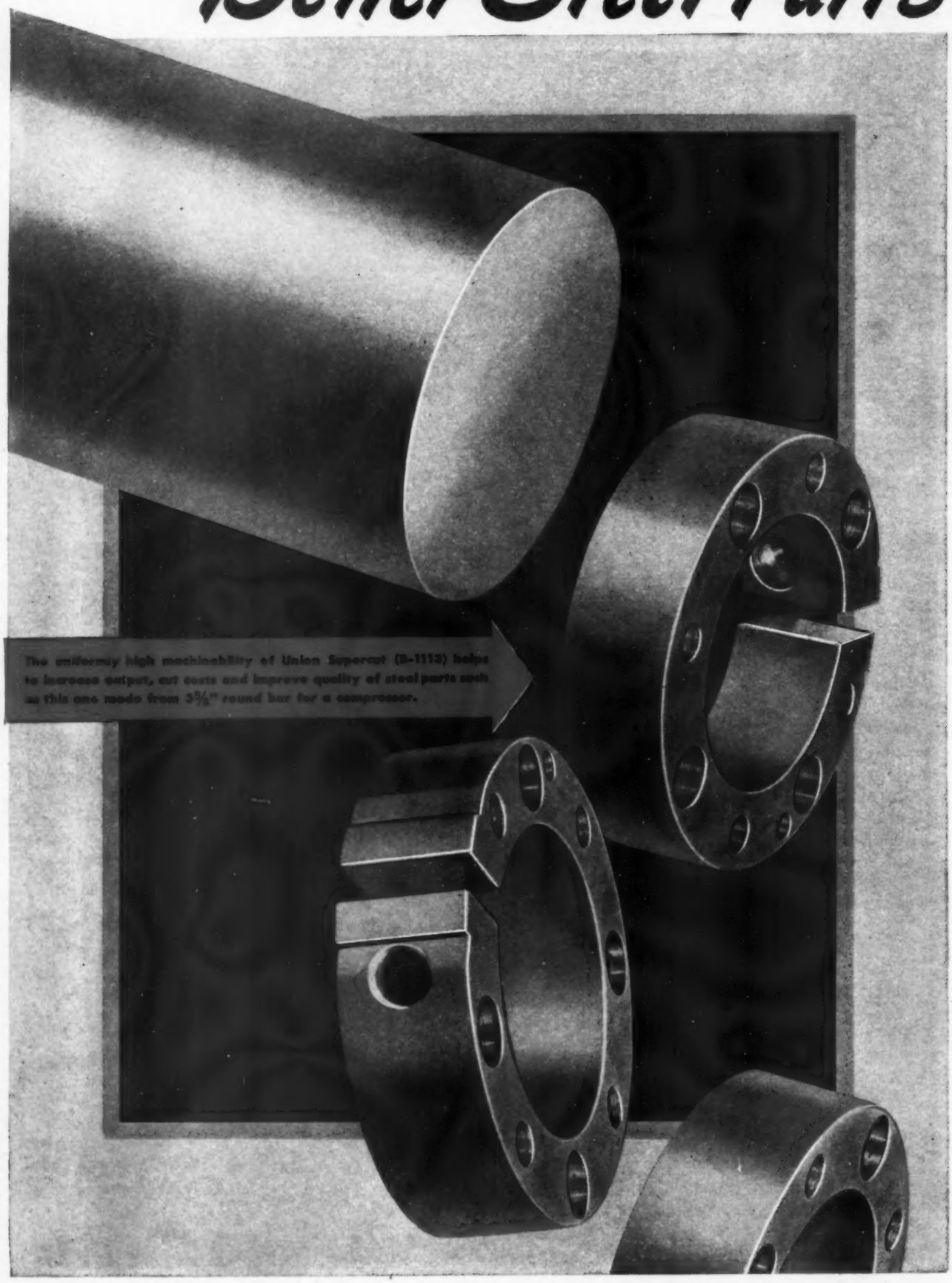
Better Steel Parts


The uniformly high machinability of Union Supercut (B-1113) helps to increase output, cut costs and improve quality of steel parts such as this one made from 3 5/8" round bar for a compressor.

...Faster...at Lower Cost

WITH THIS IMPROVED

MACHINABILITY

You can't sidestep the importance of MACHINABILITY. If you produce steel parts from bar stock by forming, milling, drilling, reaming, threading, tapping or similar operations, the machinability of the bars you use will largely determine your rate of output, your costs and your profits.

Right there is your number one reason for using Republic Union Cold Drawn Steel Bars —because in their manufacture, MACHINABILITY is placed above every other quality.

In Union Drawn laboratories, metallurgists constantly search for new ways to increase machinability, to lengthen tool life, to obtain better machined surfaces, to develop uniform response to heat treatment.

At the same time, engineers cut up tons of steel bars on the latest model "automatic" to study machining performance at various feeds and speeds. And they spend long hours in customers' plants watching steel bars perform under actual operating conditions.

To further improve MACHINABILITY, and to assure uniform hardness and physical properties, capacity has been greatly increased in all Union Drawn plants for furnace treatment—annealing, normalizing, stress-relieving, spheroidizing and other heat treatments.

Today, Republic Union Cold Drawn Steels are rated "tops" by many parts producers. And Republic metallurgists and engineers are ready to help you get the same high performance—better steel parts—faster—and at lower cost.

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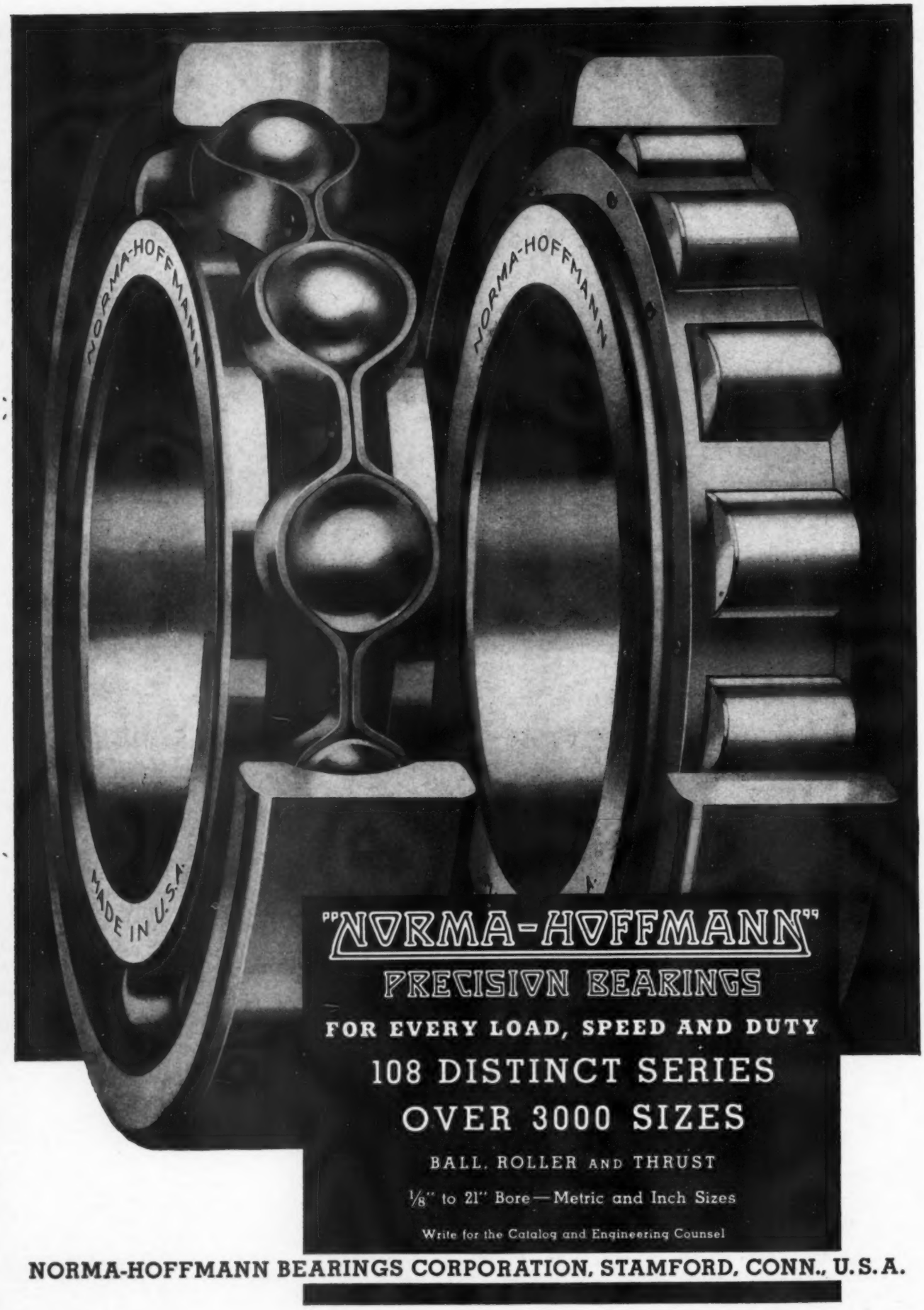
Union Cold Drawn and Ground Rounds; Turned and Polished Rounds; and Turned, Ground and Polished Rounds (Union Precision Shafting.)



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1/8" to 21" Bore—Metric and Inch Sizes

Write for the Catalog and Engineering Counsel

NORMA-HOFFMANN BEARINGS CORPORATION, STAMFORD, CONN., U.S.A.

INDEPENDENT INVESTIGATOR FINDS

Sonotone uses Phillips Screws to reduce case breakage 90%

This investigator from James O. Peck Co., industrial research authorities, is visiting a number of representative plants to get authentic FACTS on assembly savings.

GET HIS FACT FILLED REPORTS ... GET THE COMPLETE STORY

Every driver skid eliminated saves $1.35 reclaiming costs!

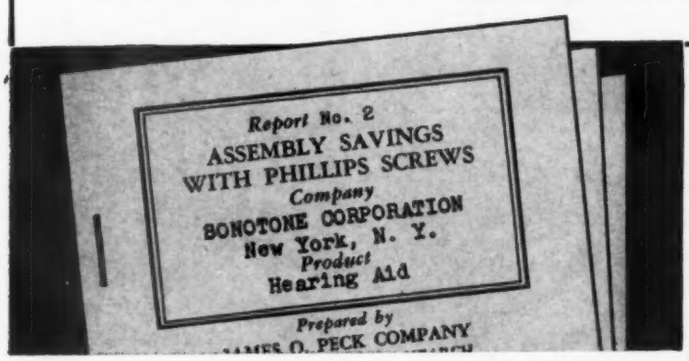
SONOTONE CORPORATION uses Phillips Screws because they lower costs and improve the product . . . the same simple but all-important reason why thousands of other successful manufacturers use them.

TO GET THE FACTS, to determine the actual savings, the investigator studied Sonotone's assembly methods, asked the same questions you would ask. He was told that, with slotted screws, breakage of the fine, hard plastic case of the Sonotone hearing aid would be ten times greater than with Phillips screws. Reclaiming, which involves not only the cost of a new case half, but also the cost of disassembly, reassembly and careful matching up of

case halves, amounted to $1.35 per unit. The burr-free, ornamental Phillips recess is another reason why Sonotone chose Phillips Screws. Read the complete, revealing story in the Sonotone report.

THE ASSEMBLY STUDIES cover all types of products – metal, plastics, wood – show how the many Phillips Screw advantages add up big savings you can make in your assemblies.

THE REPORTS now ready – and more to come – comprise a practical manual of modern assembly methods, never-before-printed information, inside facts you'd pay good money to get, – and it's yours, now, FREE!



PACKED WITH IDEAS FOR SAVINGS IN YOUR ASSEMBLIES!

Whatever you make you'll find how all assemblers licked problems like your own. Get these reports. The coupon will bring those ready now, and the rest as they are issued. Fill it in and mail it – TODAY!

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Wood Screws • Machine Screws • Self-tapping Screws • Stove Bolts

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PHILLIPS SCREW MFRS.,
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Please send me the reports on Assembly Savings with Phillips Screws

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Company .....

Address .....

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Why compromise?

WHEN YOUR PRODUCT DEMANDS SPECIFIC "HARD-TO-GET" PROPERTIES

—Put it up to Alloy Steel!

TODAY, there is no longer any need to be satisfied with "makeshifts" when it comes to steel. No longer need you sacrifice one desirable quality in order to obtain another. The time is past when your entire fabrication processes must be revamped to suit the steel obtainable.

Today, in U·S·S Carilloy Steels, we can place at your disposal a *complete* line of high quality steels. Aircraft Quality Steels—Bearing Steels—Creep Resisting Steels—Nitralloy Steels — Triple-Alloy and Special Analysis Steels, as well as other AISI and S.A.E. Steels. In all grades, in all finishes and treatments—and in the widest range of forms and sizes available anywhere.

In these special purpose steels you can obtain practically any combination of desirable properties to exactly fit your product requirements and your fabricating processes. Here is what approaches a steel user's Utopia—but it also involves a definite hazard. For unless you have *all* the facts*, it is hard to determine what particular steel will give you the best results from the *economic* viewpoint.

In this connection the cooperation of our steel specialists can save you both grief and money. Our metallurgists have been right in the forefront of the metallurgical developments fostered by the war. They have materially assisted in the tremendous advances recently made in steel application — many of which are still comparatively little known. Let them tell you how you can apply this very latest information for the improvement of your operations, for the betterment of your product, and the reduction of its cost.

EVERY SUNDAY EVENING, United States Steel presents *The Theatre Guild on the Air.* American Broadcasting Company coast-to-coast network. Consult your newspaper for time and station.

**Alloy Steel "know how" that pays off!*

A rather intricate part in a well-known car overdrive required high case and core hardness to withstand extreme wear and shock loads. Steels to meet such requirements are generally difficult to machine and in this particular part, machining costs were exceptionally high.

When our metallurgists were called in for this job they had just completed a comprehensive survey of all carburizing steels. This led them to recommend the use of another steel, which while considerably more machinable, was superior in physical requirements—and in addition, cost $20.00 per ton less than the original steel used. As each part required 10 lbs. of steel and 1000 parts per day were being produced, the raw steel saving was 10 cents per unit or $100 per day. Figuring on 25 working days per month, 300 days per year, this yearly saving in steel alone amounts to $30,000. And that's not all—10 cents per part was saved in machining, so that the actual economies were doubled—$60,000 per year—and superior physical properties were obtained as well.

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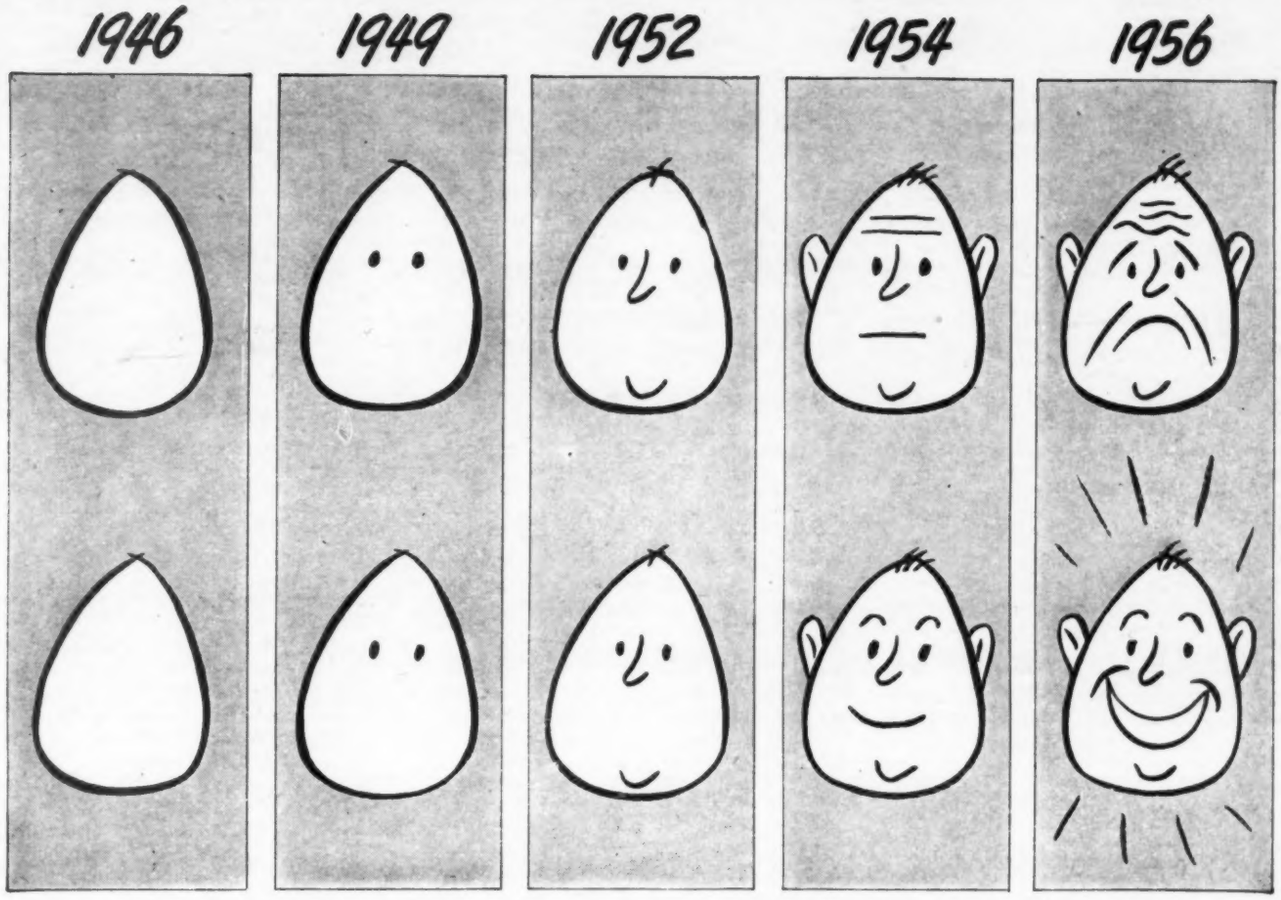
UNITED STATES STEEL



Two ways your face can grow in the next few years

USUALLY, our faces show what's happening to us. For instance, suppose financial matters are constantly on your mind.

Suppose you know that there's practically no cash reserve between you and trouble.

It would be surprising if your face didn't show it.

But suppose that, on the contrary, you've managed to get yourself on a pretty sound financial basis.

Suppose that you're putting aside part of everything you earn . . . that those dollars you save are busy earning *extra* dollars for you . . . that you have a nest egg and an emergency fund.

Naturally, your face will show *that*, too.

There's a simple and pretty accurate way to tell which way your face is going to go in the next few years:

If you are buying, regularly, and holding as many U. S. Savings Bonds as you can, you needn't worry.

Your face will be among the ones that wear a smile.

Buy all the Bonds you can... keep all the Bonds you buy

AMERICAN MACHINIST

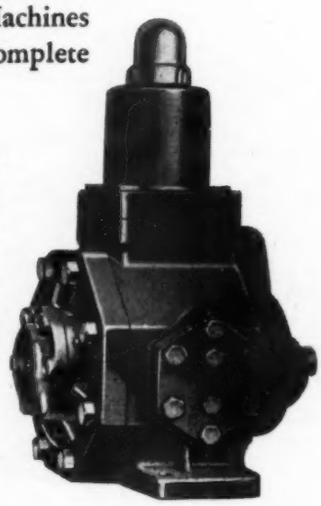
This is an official U. S. Treasury advertisement—prepared under auspices of Treasury Department and War Advertising Council

. . . at a hundred different spots

The picture above was taken in the plant of a big, nationally known metal fabricator; user of more than one hundred Racine heavy duty Hydraulic Production Saws. Stock rests illustrated are the customer's own design and construction. The machines are used for cutting billets, and shaped materials in production quantities, as well as for test cuts and special operations.

Repeated purchase of Racine Equipment was based on specific performance records. Easy loading, accurate work, big output, dependability and low upkeep costs insure continued economies, to meet current competition and high labor costs.

Racine Machines provide these features. Single lever control of powerful hydraulic, progressive feed, the correct metal cutting principle. Open front for quick loading and pivoted arm for proper blade application. Rugged construction with few moving parts. There are several models of Racine Machines in all capacities from 6" x 6" to 20" x 20". Ask for copy of our complete catalog No. 12.



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Power movement operations can be handled to better advantage with hydraulic force. Use RACINE variable volume Pumps, available in capacities from 0 to 30 G.P.M. Pressures from 50 to 1000 lbs. P.S.I. Control Valves for hydraulic circuits from 3/8" to 1½" I.P.S. Get our catalog P-10-C. Write today.

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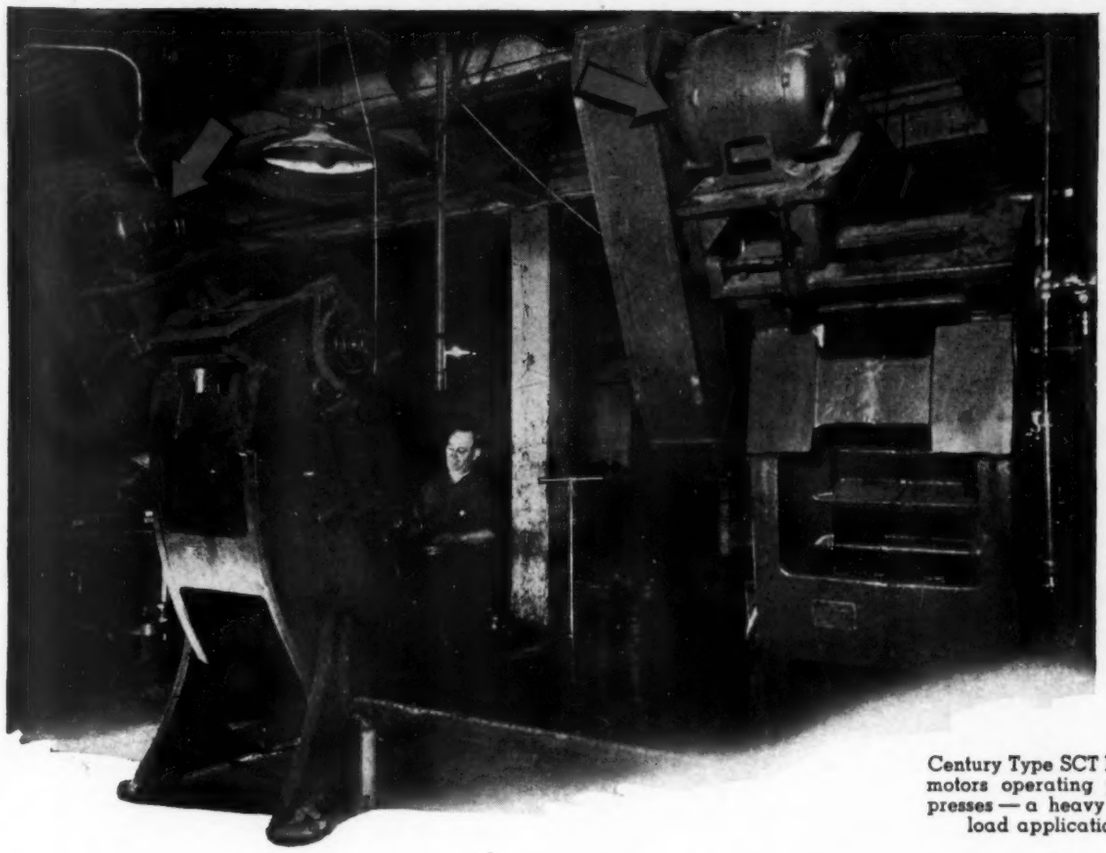

Century Type SCT Form J motors operating punch presses — a heavy shock load application.

PROLONG EQUIPMENT LIFE•

By Reducing the Impact of Shock Loads... with CENTURY High Torque, High Slip Motors

Century high torque, high slip, industrial motors (type SCT) are made for such applications as punch presses and shearing machines — where there is a sudden load impact in the operating cycle. These motors help to cushion this shock because the motor speed is pulled down as the peak load comes on.

As this peak load is reached the machine operates from the energy stored in the flywheel. Then the motor picks up speed again, and stores up energy in the flywheel for the next cycle.

Century high torque, high slip motors are particularly adaptable to applications where the length of the cycle gives time for slowing down and speeding up.

This saves wear and tear on equipment, reduces maintenance costs, saves on tools, dies, or shearing blades.

Specify Century motors on all your electrically powered equipment. Engineered to the functional characteristics of the machines they drive to assure top performance — Century motors are a vital factor in producing a better product at a lower cost.

Century motors are built in many types and sizes from 1/20 to 600 horsepower.

Century C MOTORS

455

CENTURY ELECTRIC COMPANY

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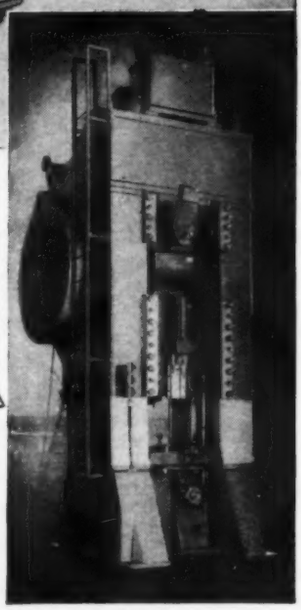
Illustrated is a pitman from a 1500-ton Verson Knuckle Joint Press. This pitman is bronze-bushed with Ampco Metal.

PROTECTION
against breakdowns at critical points...

WITH

Machine-tool parts of wear-resisting AMPCO-METAL

M-13



• *Above:* 1500 Verson Knuckle Joint Press has knuckles lined with Ampco Metal. Shuttle operates on Ampco Metal strips which take full 1500-ton pressure.

A series of aluminum bronze alloys adaptable to varying operating requirements . . .

To protect you against costly "down time" for repairs due to metal failures, foremost machine tool builders (over 90 of them) standardize on parts of Ampco Metal.

This versatile alloy — made in five grades and a number of modifications — has physical properties that can be regulated to suit the application: Controlled hardness. High tensile and compressive strength. Stubborn resistance to wear, shock, impact, fatigue, "squashing out." Good bearing characteristics. *Lasts several times as long as ordinary bronzes.*

Check for parts of Ampco Metal, as a mark of quality in the machines you buy. And insist that replacement parts for your older machines be made of durable Ampco.

FREE! "File 41 — Engineering Data Sheets" illustrates and describes many applications using various grades of Ampco Metal successfully. Shows you why it's good business to check for parts of Ampco Metal in specifications of the machine tools you buy. Fill in the coupon below for your free copy.

Tear out coupon and mail today!

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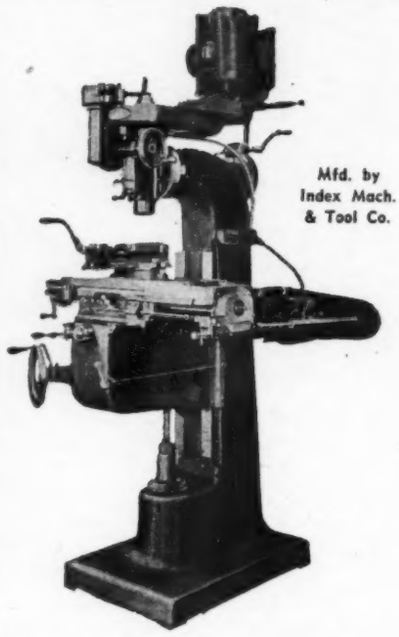
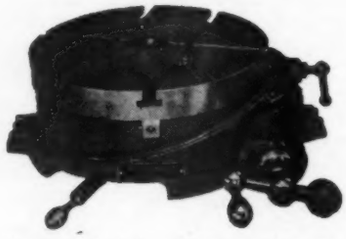
will help you on your tool, die and production work. In addition to micrometer dials on screws, verniers are standard equipment for cross and longitudinal locating. If finer precision is desired, rods and indicators are available. These in conjunction with power feed to a precision ball bearing spindle make a very versatile machine for milling, drilling and boring. *Literature promptly mailed on request.*



Mfd. by Index Mach. & Tool Co.

12" Tool Room Rotary Table



A quality tool for precision work in the tool room or production line, incorporating such features as ball bearings—hardened and ground worm—quick acting throw-out for free hand turning—single movement table lock that does not cramp table out of alignment—compound trough. 12" size only.

For use on Index Mills or any other machine that will accommodate a 12" table.

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SPECIAL COLD FORGED PARTS • STANDARD CAP SCREWS • HARDENED AND PRECISION GROUND PARTS • SHEET METAL DIES FROM THE LARGEST TO THE SMALLEST • JIGS • FIXTURES • STEAM-HEATED PLASTIC MOLDS • SPECIAL PRODUCTION TOOLS • R-B INTERCHANGEABLE PUNCHES AND DIES • DIE MAKERS' SUPPLIES

THAT's the best way to solve your steel supply problems quickly and efficiently. While our stocks today are not as complete as we would like them to be, we are making every effort to maintain balanced inventories to serve your needs better.

When you need steel, phone, write, or wire the nearest of our nine warehouses. If your order cannot be filled by one warehouse, it can often be filled quickly by another. All orders and inquiries receive courteous attention and prompt action.

U·S·S Stainless Steel available for immediate shipment!

Our warehouse stocks of U·S·S Stainless Steel include sheets, plates, bars of all kinds—rounds, squares, hexagons and angles—pipe, tubing, and welding electrodes in all standard grades and specifications.

War production has taught us new ways to use Stainless Steel. This increased knowledge is at your service. Our engineers will gladly assist in selecting the proper types of U·S·S Stainless Steel for your requirements and will help you with fabricating problems. And free technical bulletins will be sent to you upon request.

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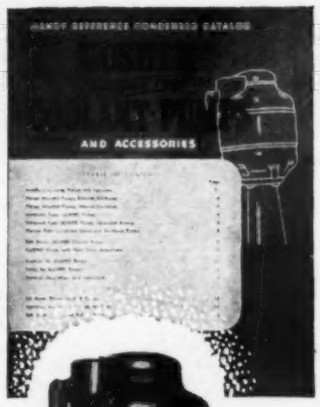
UNITED STATES STEEL

WHAT DO YOU NEED IN ...a Coolant Pump?



In choosing coolant pumps for your machines, you should consider certain points which assure you of economical, efficient and long lived operation.

Will you get split-second delivery of coolants? Is the construction simple with fewer parts to wear? Are they compact, easy to install in small spaces? Is the shaft in one piece and electronically balanced to give vibrationless rigidity? Do you have full bearing construction, no metal to metal contact?

RUTHMAN GUSHER COOLANT PUMPS

offer you these and many other advantages to help you solve your coolant problems. So if you purchase or specify coolant pumps, send for the new Ruthman Condensed Catalog.

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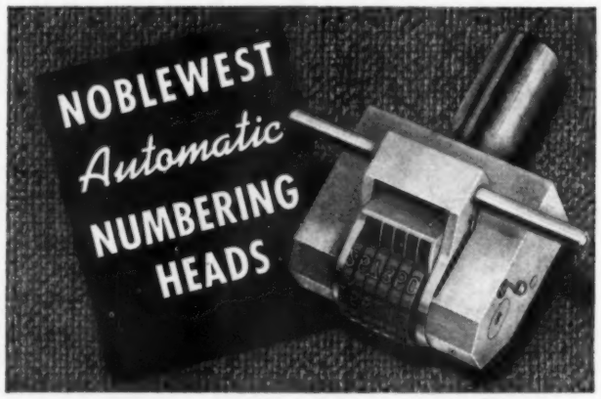
The "GUSHER"—A Modern Pump For Modern Machine Tools



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Fine Marking Tools

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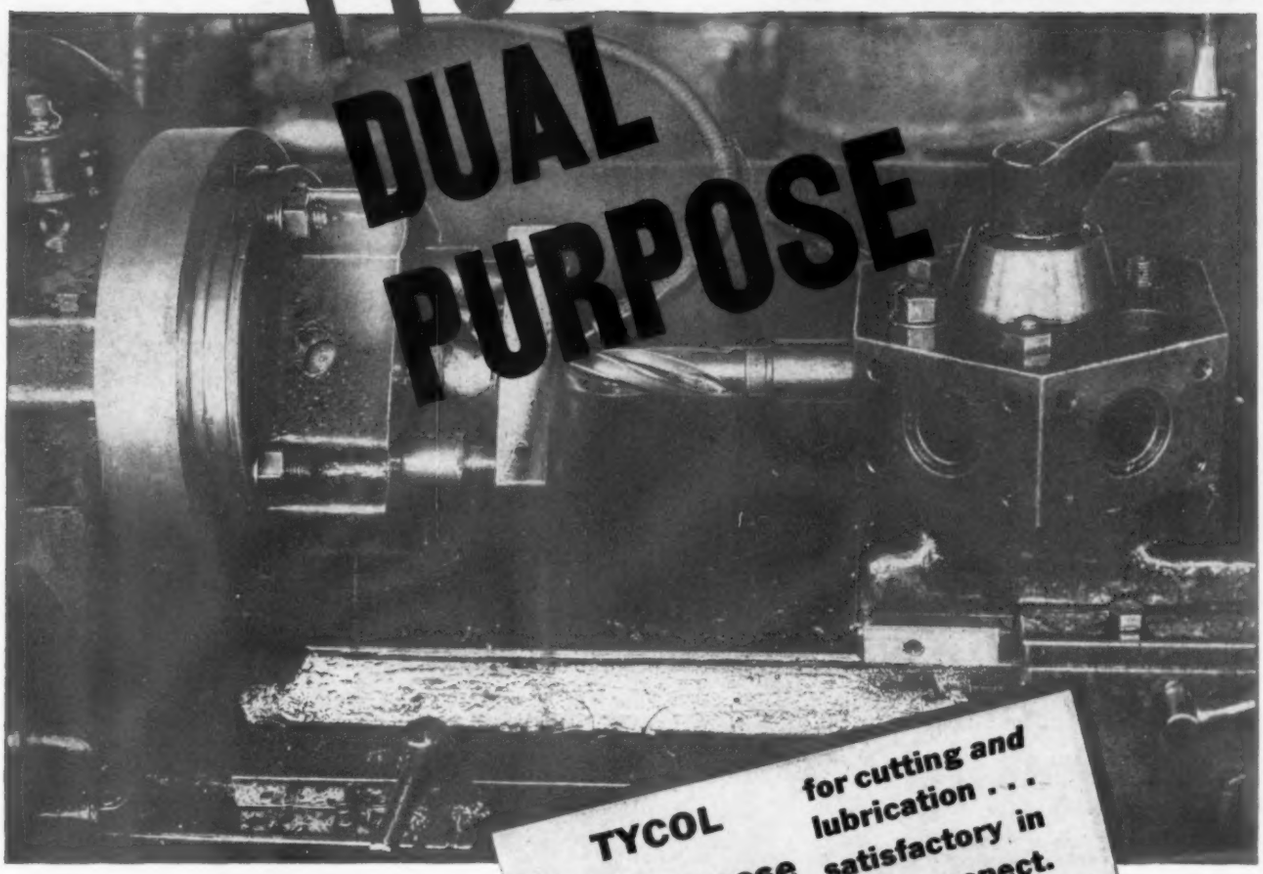
ONE OIL — TWO JOBS FOR PRODUCTION ECONOMY



TYCOL Dual-Purpose OIL for cutting and lubrication . . . satisfactory in every respect.

"CUTTING SPEEDS ARE 25% FASTER..."

"AN EXCELLENT MACHINE LUBRICANT..."

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"INCREASED TOOL LIFE..."

"IMPROVED FINISHES..."

TYCOL INDUSTRIAL LUBRICANTS

Such outstanding results are the rule — not the exception . . . when a Tycol Dual-Purpose Oil is used . . . the one versatile oil that does the work of *two* oils better and more efficiently. Call, write or wire your nearest Tide Water Associated office for full details.

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with the efficient economical
TANNATE-ROCKWOOD
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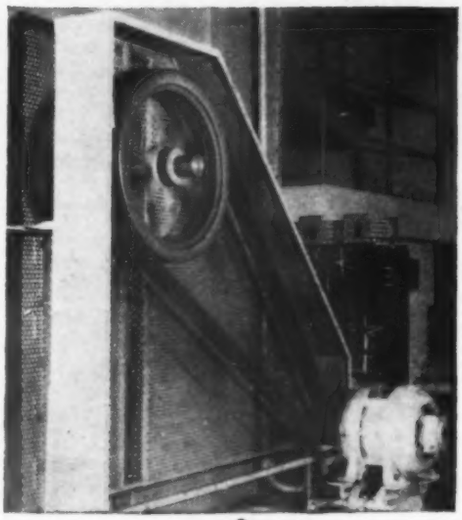


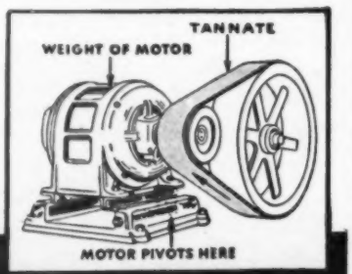
Here is a consistent, dependable drive that keeps production flowing, steadily and at a fast pace.

Efficient . . . CORRECT belt tension is maintained at all times and under any load condition, by the weight of the motor on the pivoted Rockwood base. Maximum power is delivered without undue strain on belt and bearings.

The TANNATE belt hugs pulleys with a firm grip. TANNATE is TOUGH with a strength one-third to one-half greater than choice oak belting. And TANNATE keeps this tenacious pulley grip day in and day out through a long service life, with practically no maintenance needed.

May we send you without obligation, information about this more efficient . . . more ECONOMICAL drive?

For floor, wall, ceiling or vertical drives, with large or small motors.



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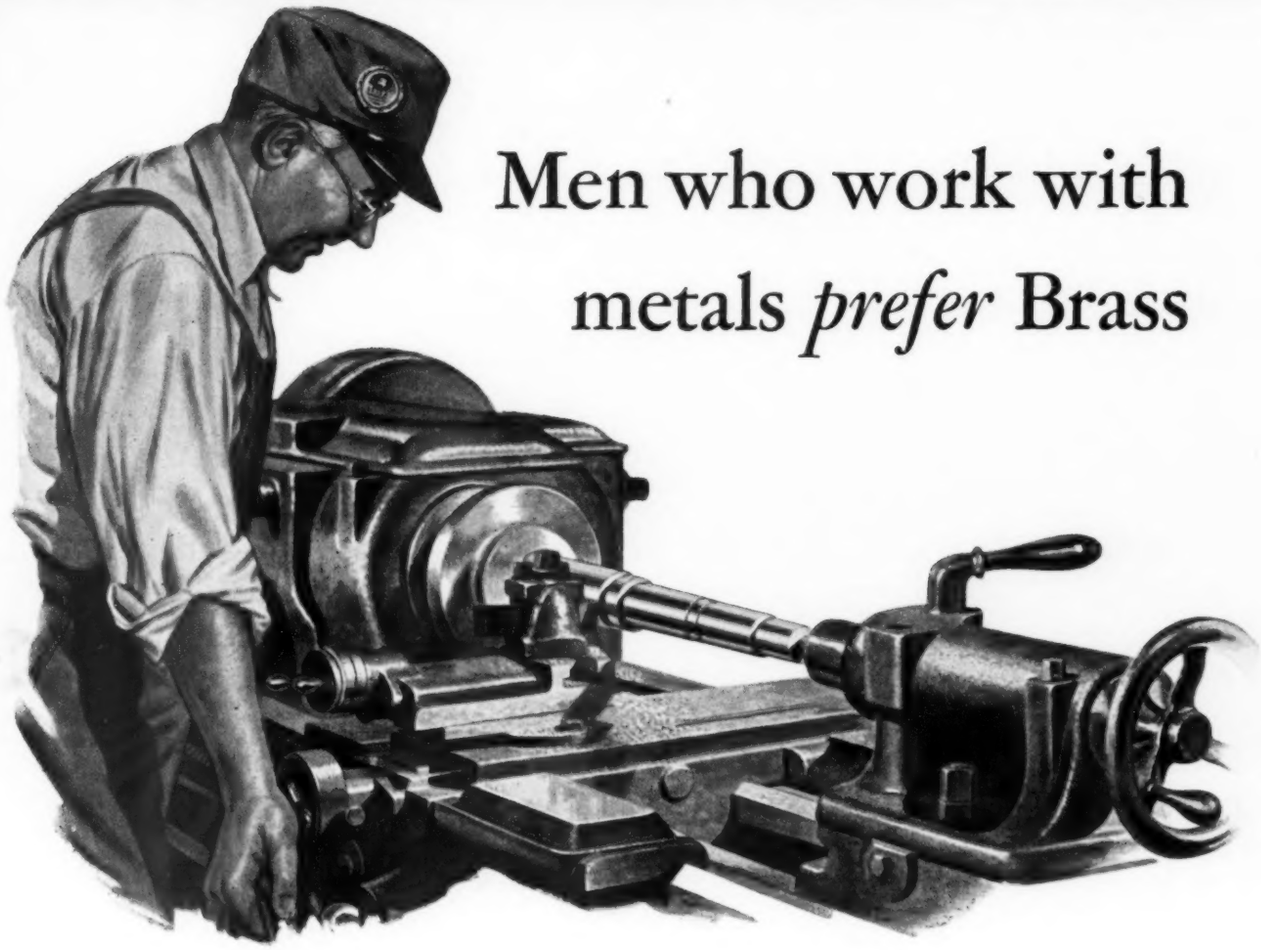

Men who work with metals *prefer* Brass

AND FOR GOOD REASONS, TOO! Brass is strong, durable, workable and dependable. It machines readily and takes an excellent finish. On lathe or milling machine, brass lends itself equally well to heavy roughing operations or high speed finishing cuts.

• For the manufacture of screw machine products, the preference for brass has been established over the years. Multiple and complicated machining operations are being performed economically on modern high speed automatics day after day—in thousands of screw machine shops.

• The ductility of brass makes it the ideal metal for press-drawn products as evidenced by its widespread use for cupping and deep-drawing operations. And what better material than brass for the rapid and accurate production of blanked, stamped or coined parts?

• On drill press or tapping machine, brass is in a class by itself, and any operator can tell you why: Holes drill faster, drills need fewer grindings; reamers hold their size longer and leave mirror-smooth holes; taps operate at higher speeds and produce clean-cut, accurate threads.

• Yes, brass *is* a workable metal. It can also be rolled, spun, soldered, brazed or welded. Having an attractive color of its own, brass also serves as an excellent, rust-free base metal for almost any applied finish.

• The uniformity and dependability of brass means faster, more efficient production—lower

Continued on next page

THE AMERICAN BRASS COMPANY

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ANACONDA

Anaconda Brass Mill Products

All these, and others, too—*from a Single Source of Supply*

Continued from preceding page

overall costs and higher overall quality. It has proved to be the most economical metal to use for a thousand and one parts and products—from brass butts to brass buttons.

● The American Brass Company produces copper, brass, bronze and nickel silver in all standard compositions and in practically all commercial forms. With the composition, grain size and temper adjusted to the requirements, these metals are readily adaptable to most production methods and equipment.

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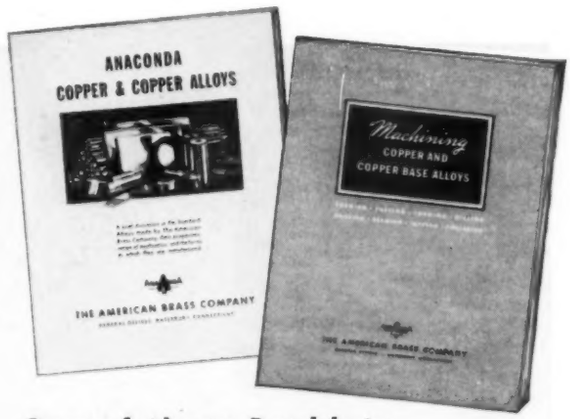

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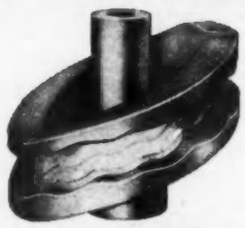

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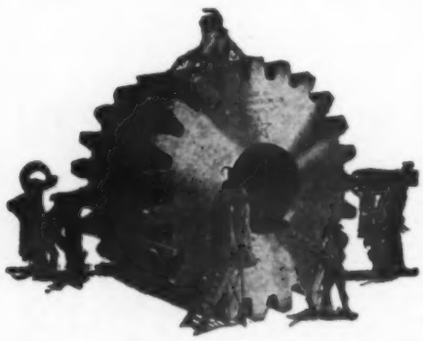

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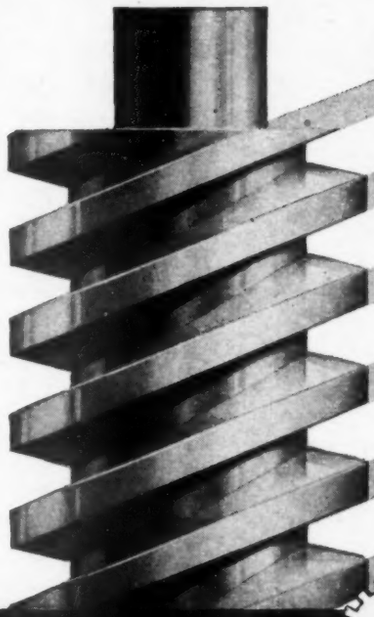

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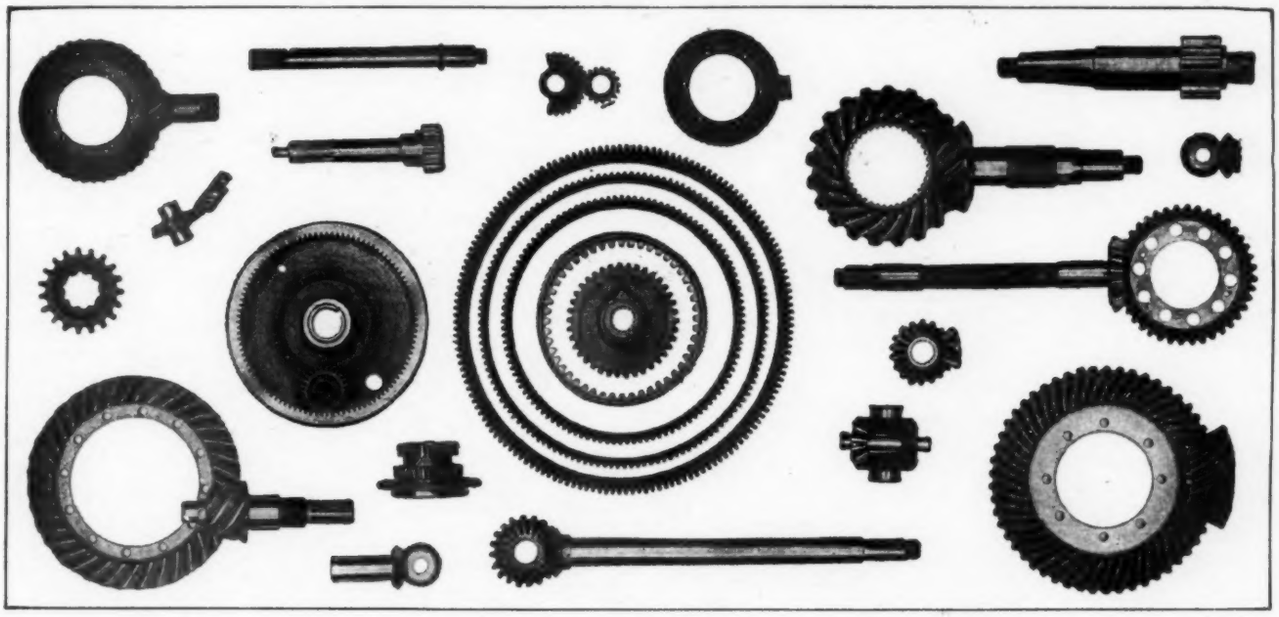

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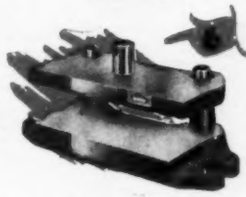

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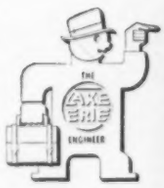

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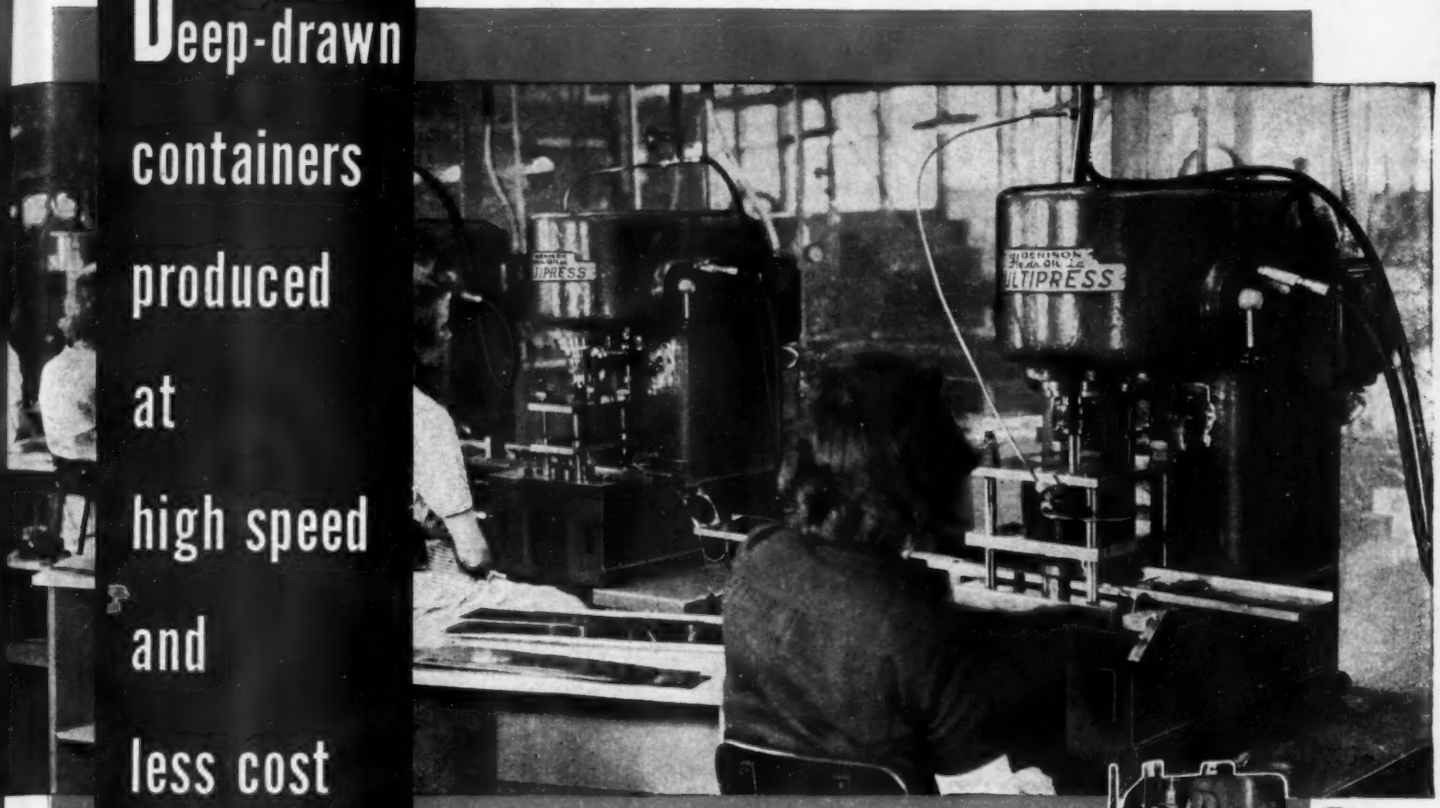

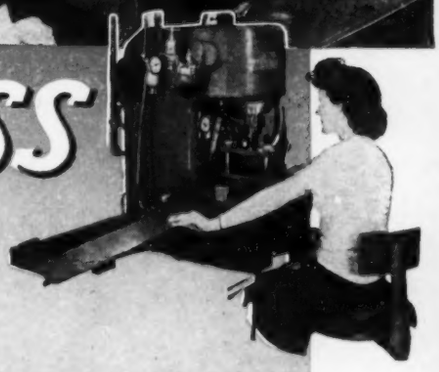

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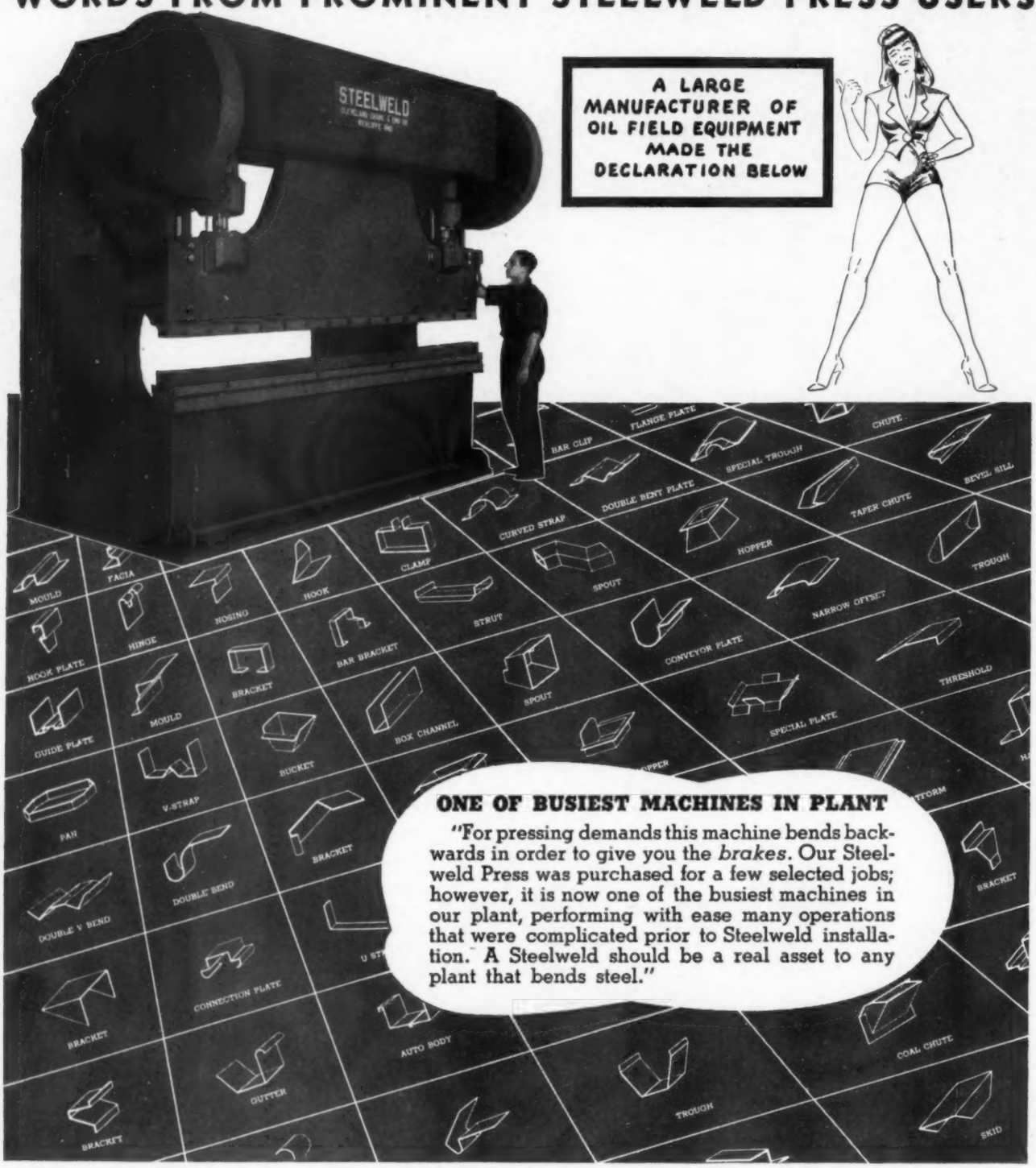

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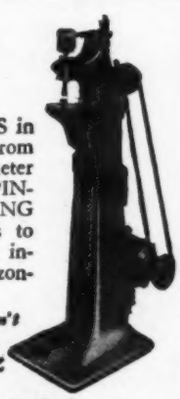

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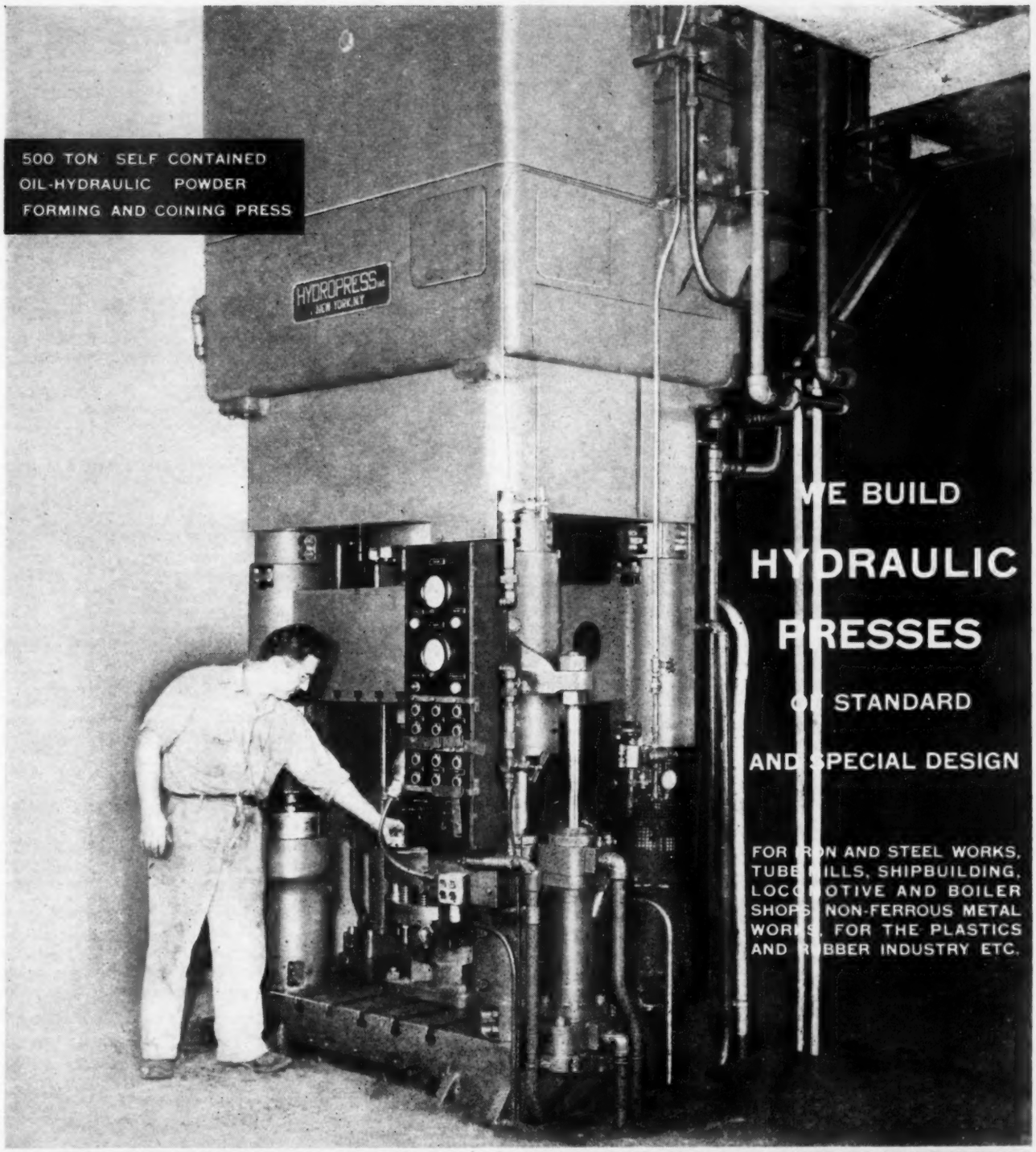

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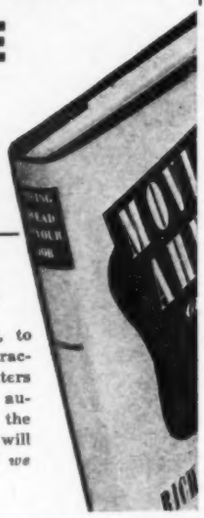

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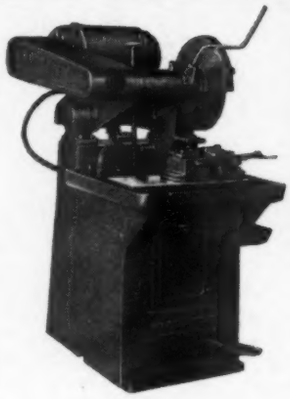
The Cincinnati WET ABRASIVE CUT-OFF MACHINE



. . . for straight or angle cutting of practically any material used in general manufacturing . . . including such metals as brass, copper, aluminum, as well as fibrous and plastic materials in various sizes, angles and shapes.

Suitable for making straight or angle cuts in solids up to 2¼" or tubing up to 3½" diameter. Same vise is suitable for various cuts. Maximum capacity is 2¼" in cutting angles up to 45°. Graduations on table make angle-cutting fast and accurate.

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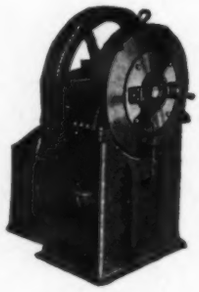

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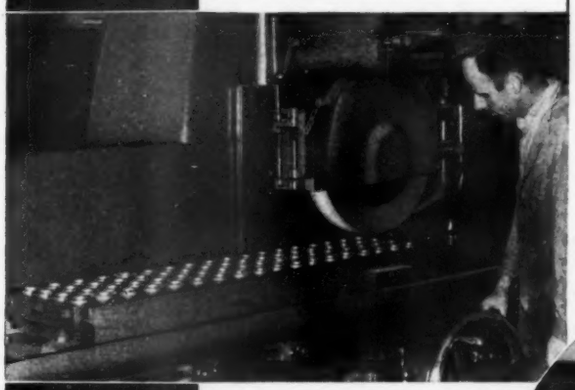
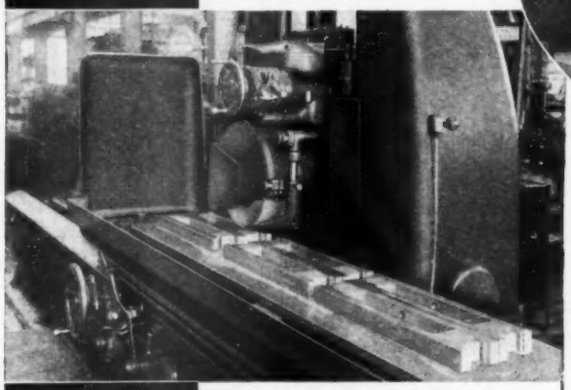
LARGE TABLE SPACE MEANS MORE PIECES PER LOAD AND GREATER PRODUCTION *with the Mattison Grinder*

● Cross Slide Draw Bars formerly ground 5 pieces at a time. Now ground on a Mattison Grinder 27 pieces per load. 50% time saving.



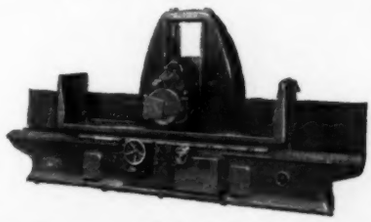
● Caps previously ground few at a time on small grinder. Now, Mattison Grinder handles 75 at a time. Time was reduced from 7 hours to 30 minutes.

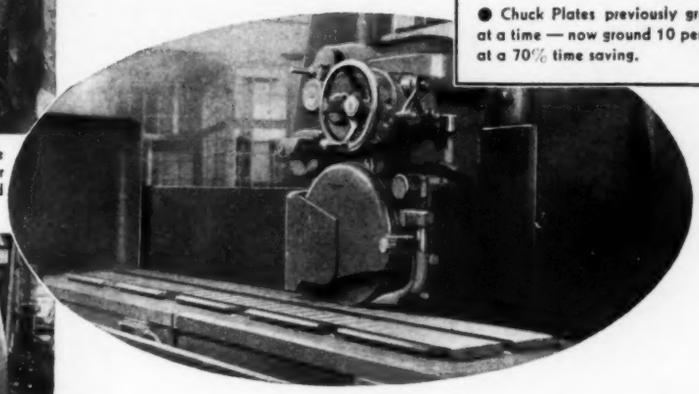


● Head Slide Guides formerly ground one at a time in 36 minutes — Now ground on a Mattison Grinder 9 pieces per set-up at a 77% time saving.

Examples: Grinding 75 pieces per load instead of 18 — cut time 80% . . . . . 10 pieces per load instead of 2 — cut time 70%, etc.

Jobs shown indicate the possibilities for increased production by handling large quantities per set-up. In your efforts to obtain maximum production and lower cost, it will pay you to check into the capabilities of the Mattison Grinder.





● Chuck Plates previously ground 1 at a time — now ground 10 per set-up at a 70% time saving.

ADDITIONAL INFORMATION

Also available is free Set-Up Book showing further examples of work ground on Mattison Grinders — Send for a copy today.

MATTISON MACHINE WORKS

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From Woody Spencer's Notebook

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in the Movies, But It Won't Pay in Tapping

Some fellows just can't seem to get the idea that precision tapping CAN BE fast. But time after time it's been proved that the best work is done when the tap is run at the highest speed consistent with the material, lubricant and type of machine used. There's a good cutting speed table in my Handy Tapping Guide. Run your taps at the proper speed and you'll find you get smoother, more accurate threads, faster production and longer tap life.

These Tapping Tips aren't designed to carry engineering advice on tapping problems. They're really friendly hints, picked up by Woody from the boys in the shops he calls on, and passed on for whatever good they'll do. If they make some job run a little easier or quicker or maybe cut costs or save some headaches, we'll feel they're well worth while. The individual technical problem that comes up so frequently should have a definite engineering recommendation. If you will send us complete data—material, type of hole, diameter and depth, lubricant, etc., our engineers will be glad to offer specific suggestions.

NOTE: Woody Spencer's Tapping Tips will appear here as often as Woody gets time to write them up. Look for them.

Woody Spencer's Handy Tap Guide is full of helpful information on tapping. It's all arranged in convenient indexed form for quick, easy use. *It's FREE. Write for your copy on the company letterhead.*

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- —training in the various operations performed in drilling and surfacing materials in the machine shop
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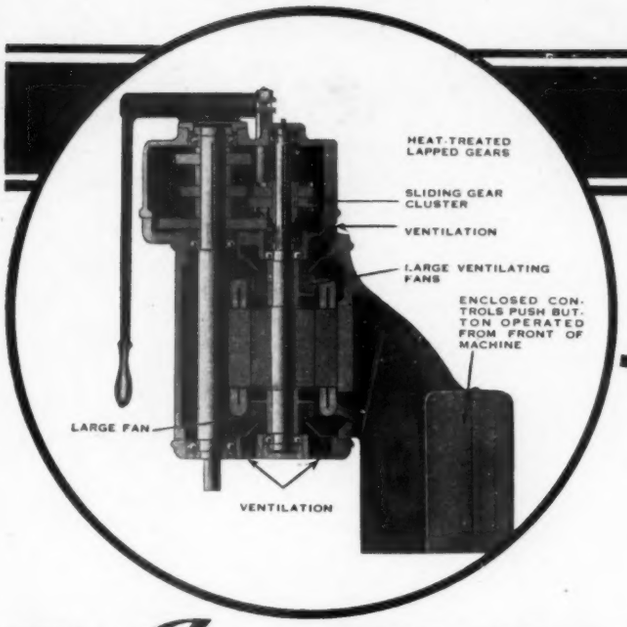

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AVEY-MATIC POWER FED HAND FEED AND REVERSING MOTOR TAPPING MACHINE

features

motor and gear box construction of six speed machine

Motor mounted directly back of spindle with gearing between motor and spindle drive sleeve. Two speed motor, three speed transmission. Only one pair of gears in mesh at any spindle speed. Motor and spindle drive mounted on ball bearings, fan ventilated motor.

Type MA-6 is made in following capacities:
No. 2 — 7/8" capacity in cast iron.
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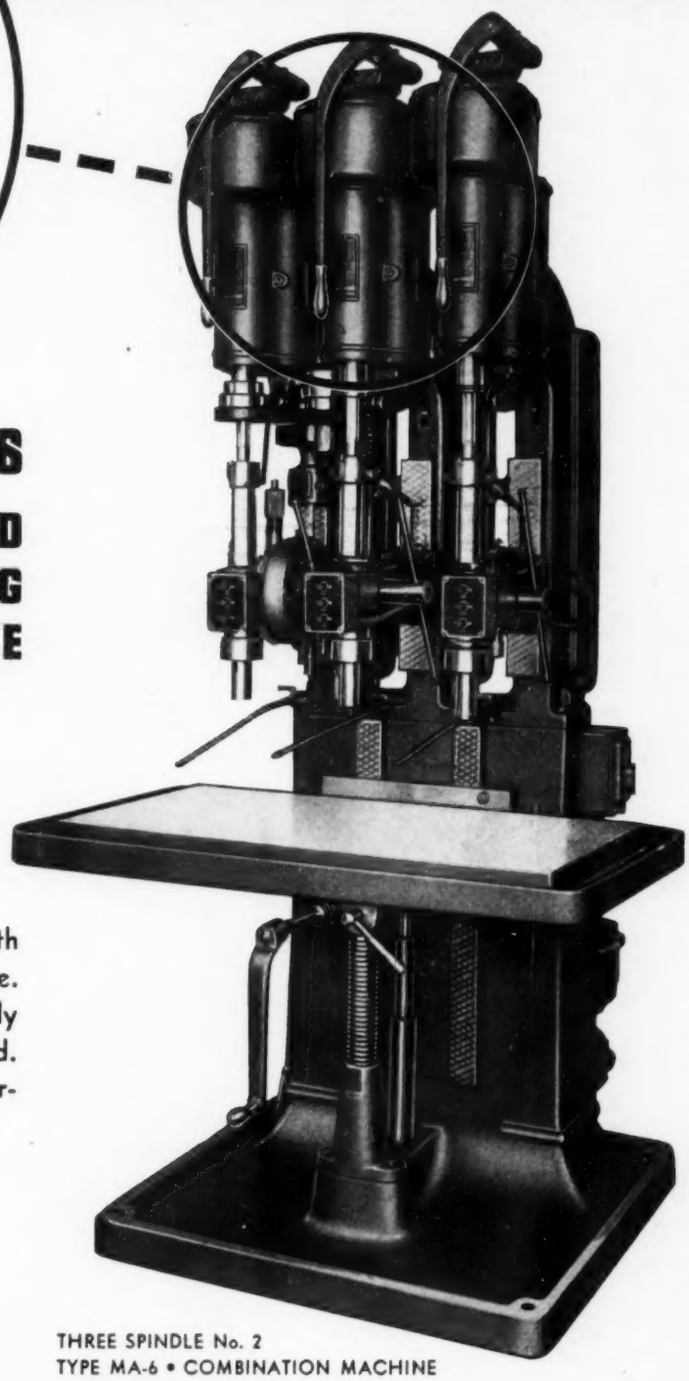

THREE SPINDLE No. 2
TYPE MA-6 • COMBINATION MACHINE
1st Spindle - Avey-matic Feed
2nd Spindle - Hand Feed
3rd Spindle - Tapping (Reversing Motor)

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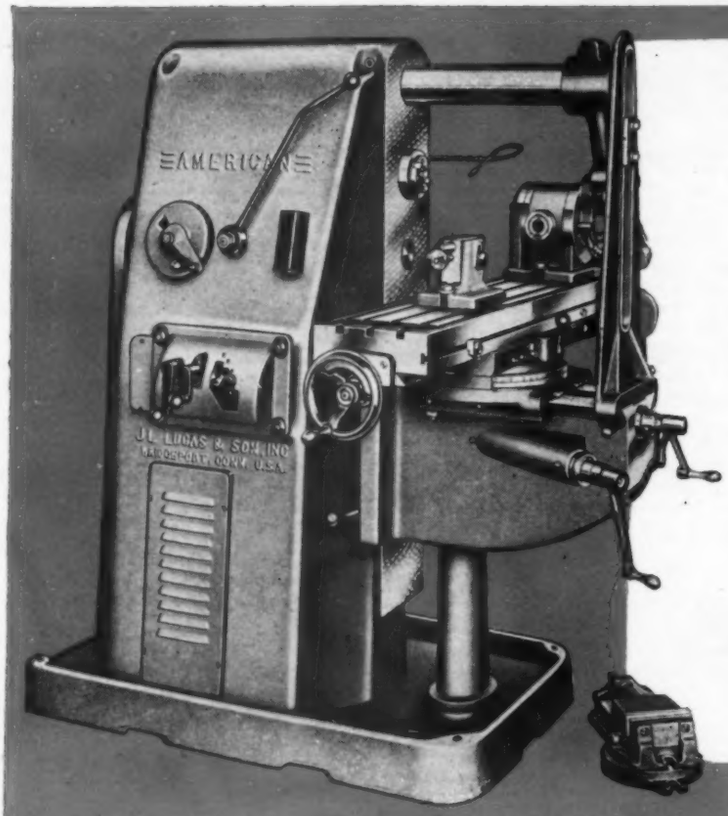

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T-slots—3-11/16"

RANGE—Longitudinal Power Feed—25"
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SPINDLE—Standardized Flanged Nose—No. 40 Taper
Hole through spindle—21/32" dia.
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Speeds—Infinite—Range 25-500 RPM

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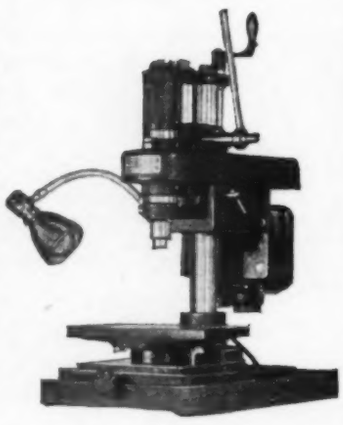

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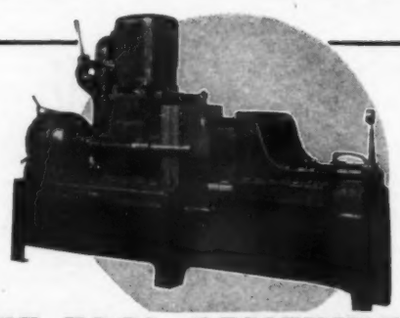

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Electric Feed Drive With Rheostat Control

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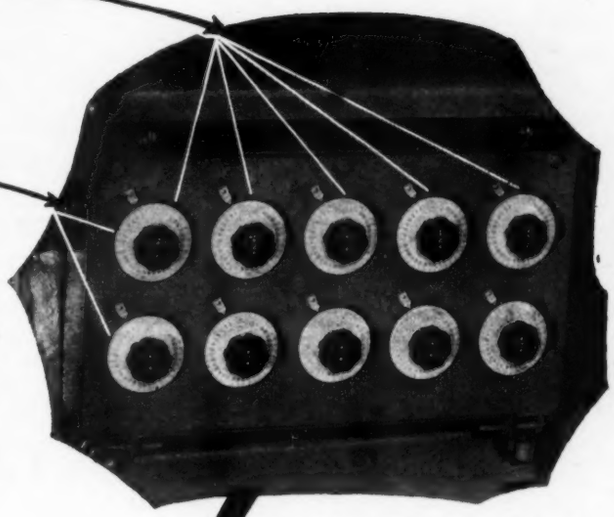

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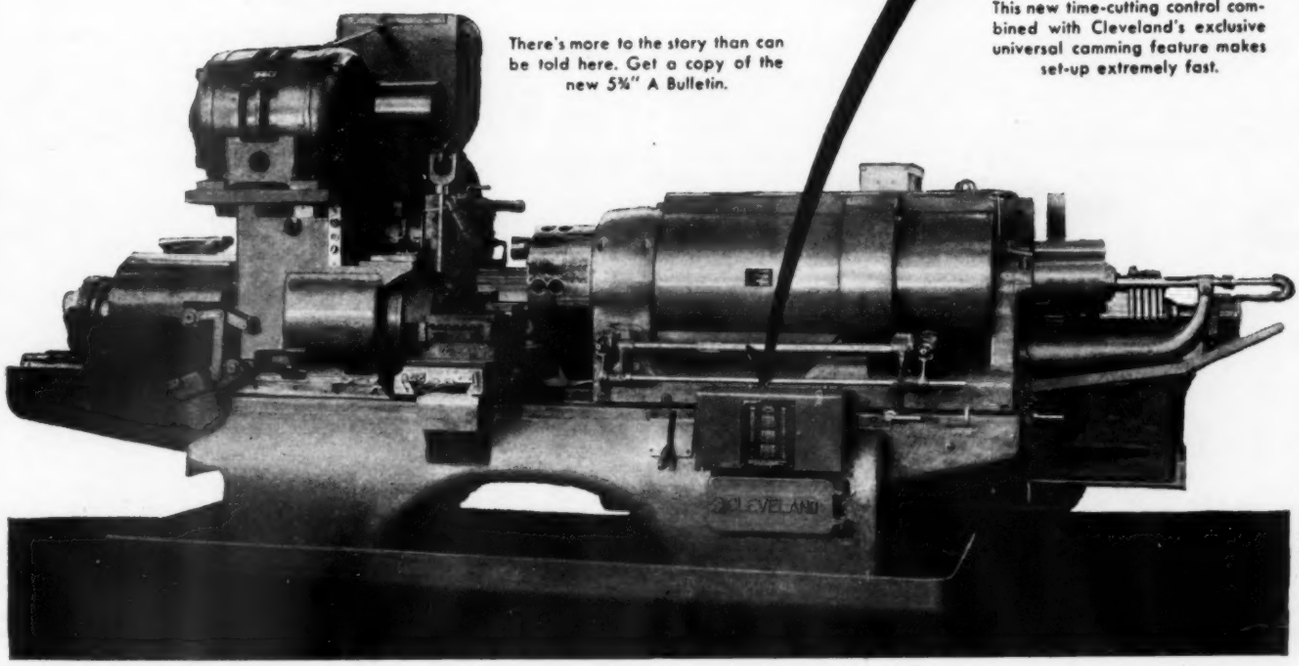

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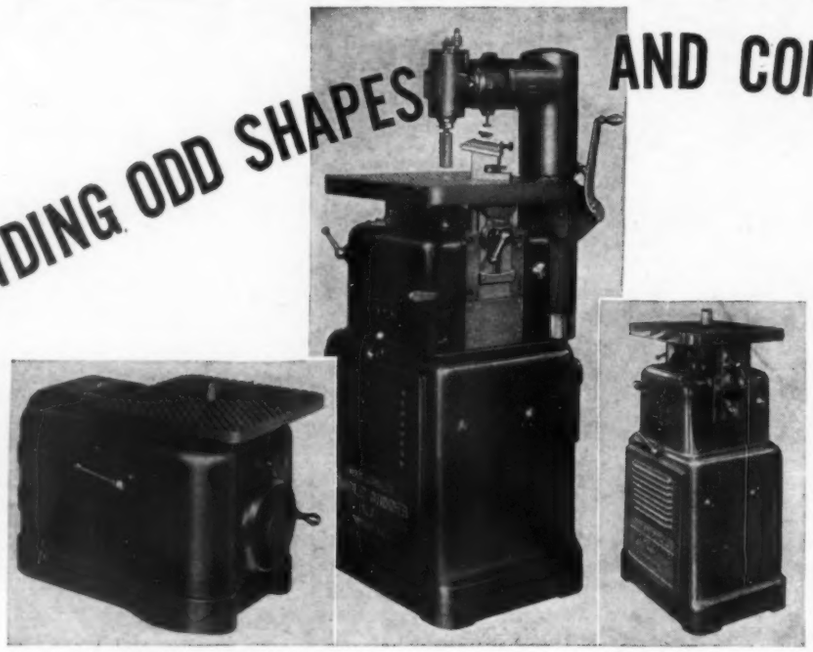

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A bench size Tool operating at 20,000 R.P.M. with vertical oscillations. For grinding die clearances, sharpening punches and economically finishing cams and templates. In production grinding too, this Grinder has proved a valuable tool.

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Reaming 2,200 holes per hour with a single unit.

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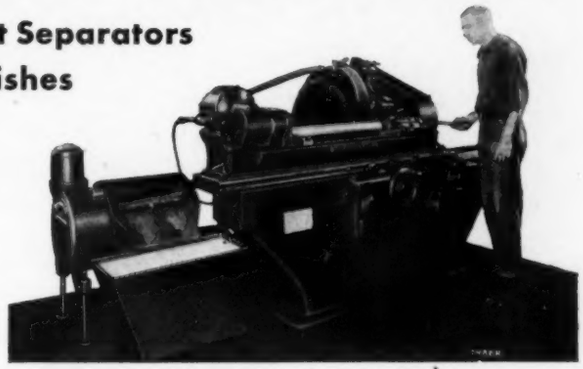
BARNESDRIL Magnetic-Automatic Coolant Separators Assure Smoother Honed and Ground Finishes

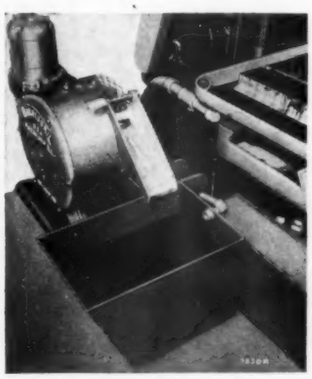
Where honing machines or cylindrical, internal, surface, disc, centerless, crankshaft and other wet grinders, including thread grinders are in use, the installation of a BARNESDRIL Magnetic-Automatic Coolant Separator will prove an economical and time-saving investment in coolant and cutting oils, and also automatically assure a better quality, finished product. By using the BARNESDRIL Coolant Separator—an efficient, trouble-free, fully automatic unit—your honing and grinding machines are constantly supplied with the maximum gallonage of *cleaned coolants and cutting oils* from the reservoir for immediate and constant re-use . . . coolants free of all injurious particles, thus assuring a mirror-like, smooth-finished job.



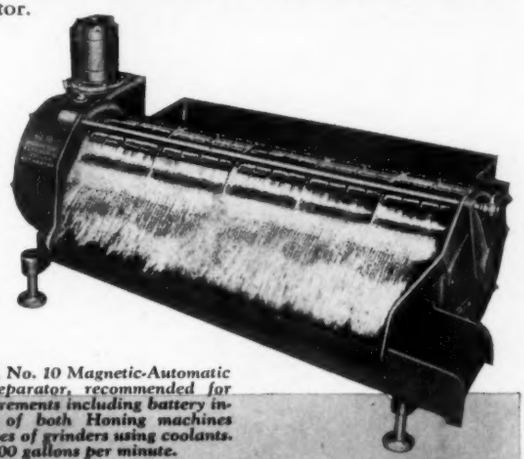
BARNESDRIL No. 4 Magnetic-Automatic Coolant Separator attached to a Brown & Sharpe Cylindrical Grinder. This Separator handles an over-capacity supply of coolant—55 gallons per minute.

Of compact design . . . simply, easily installed . . . the BARNESDRIL Coolant Separator is automatic, continuous or intermittent in operation; controlled by a start-and-stop button. It definitely removes all harmful magnetic chips and most of the abrasive particles from coolants as they flow rapidly through the lower part of the Separator to the reservoir for recycling.

Low in initial cost, with maintenance costs reduced to a minimum since filters are not used. Accumulated swarf and abrasive particles are automatically scraped off and carried through an inclined chute to a removable pan, requiring no attention of the operator.



BARNESDRIL No. 0 Magnetic-Automatic Coolant Separator attached to a BARNESDRIL No. 249 Honing Machine. Capacity — 5 gallons per minute.



BARNESDRIL No. 10 Magnetic-Automatic Coolant Separator, recommended for large requirements including battery installations of both Honing machines and all types of grinders using coolants. Capacity 100 gallons per minute.

Available in five sizes—5, 10, 20, 40 and 100-gallon coolant capacities—the BARNESDRIL Coolant Separator helps to produce mirror-like finishes by constantly supplying cleaned coolant to the work. Machine down-time is eliminated . . . machines do not have to be stopped to clean out sludge.

Our Engineering Department will show you how simple it is to attach a proper size BARNESDRIL Magnetic-Automatic Coolant Separator to your honing or grinding machines. This service is available, without obligation.

TODAY . . . Send for Bulletin A-151 which shows many interesting applications of the BARNESDRIL Coolant Separator in actual plant operation.

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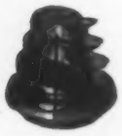

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S-27

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for automatically performing any one or a combination of metal cutting operations
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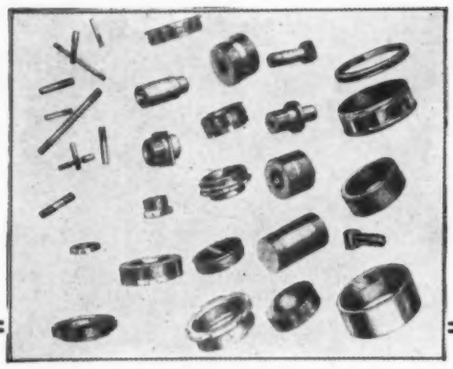
Any parts that can be chucked can be threaded on the COULTER HOB THREAD MILLER



. . . a universal machine for automatic production of internal or external right or left hand threads

Hob Threaded work can be handled with speed and precision on this rigid, simple fully motorized machine. The variety of work it is capable of handling is almost unlimited because any parts that may be held by chuck or special fixture can be threaded. The design of this machine is such that long work can also be accommodated.

Work and cutter spindles are each driven by individual motor, a wide range of speeds and feeds being available for threading of parts of various materials. Once the machine has been started on the first piece, the entire operation is automatic until time for unloading.

Explore the possibilities of the "Coulter" on your external and internal threading by writing for further information.

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of TRIMMING FORMED PARTS
and performing a host of other metal cutting jobs!

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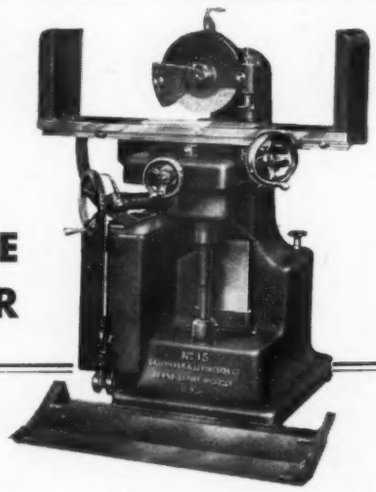

. . . a rugged machine for fine, accurate work

This high grade, motor driven machine will handle all work within its capacity with maximum convenience. Among the features which assure fine, accurate work and long precision service are the following:

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. . . precision ball bearing spindle
. . . careful guarding of wearing surfaces
. . . provision for wet grinding

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Longitudinal Table Movement—19"
Transverse Table Movement—8½"
Vertical Movement—12"
Table—6"x18"

Send for illustrated literature giving further details.

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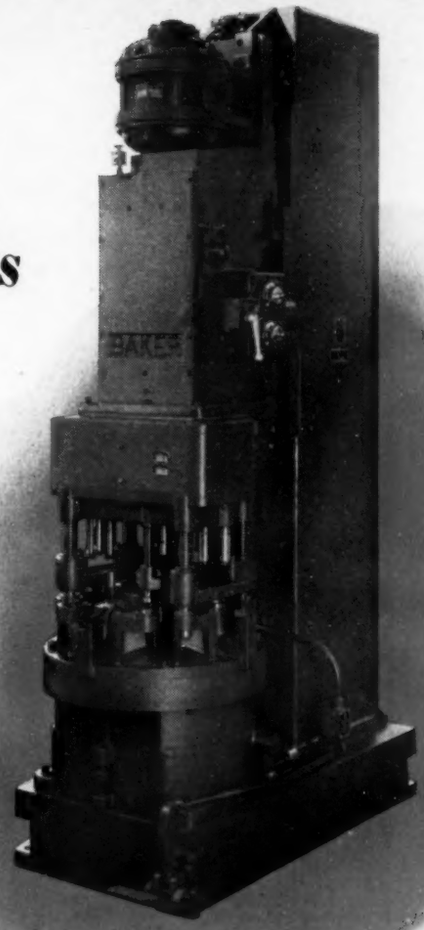

Here versatility is keynoted by BAKER'S 7½ AA 14 unit machine. Shown at right is a vertical application, furnished for multiple drilling in one part at one chucking . . . accomplished by means of a hand index table mounted on the base. Loading and unloading is done while machine is cutting.

Below, an application of the 7½ AA 14 unit with multiple spindle head in horizontal plane. This machine, equipped with a 12 station rotary index trunnion fixture, was furnished for multiple drilling a ball nut part for steering gears . . . 4.406 holes drilled, countersunk and end milled and 3¼" clamp holes drilled in one face.

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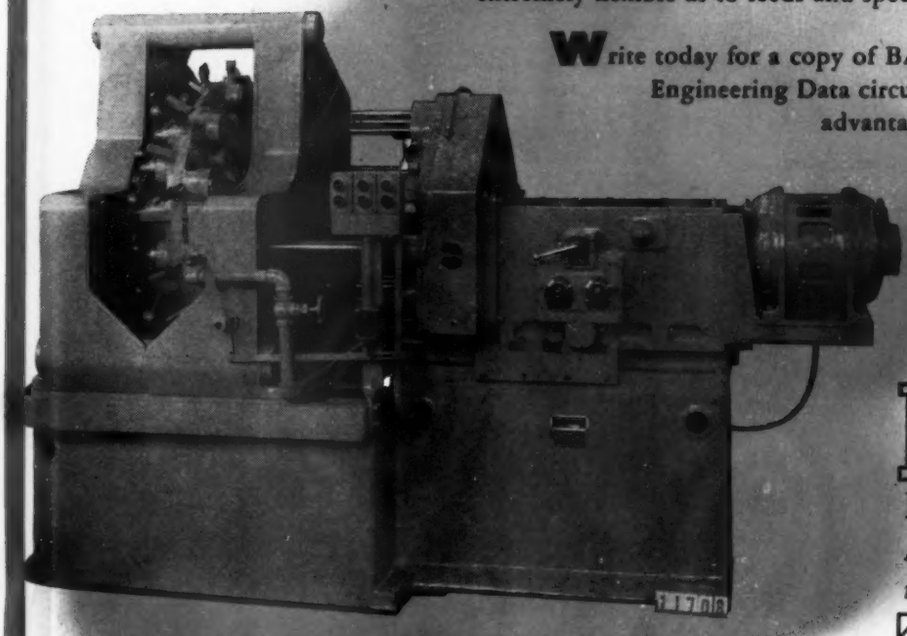

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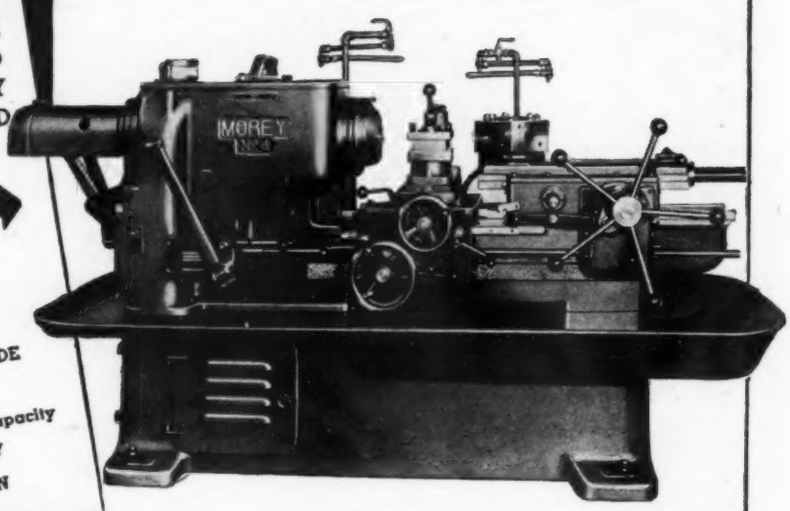

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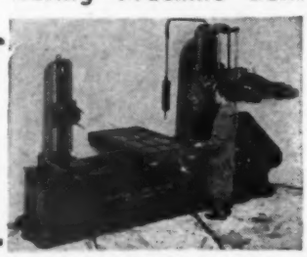

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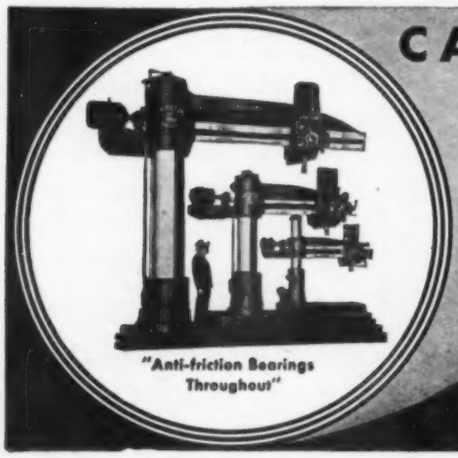

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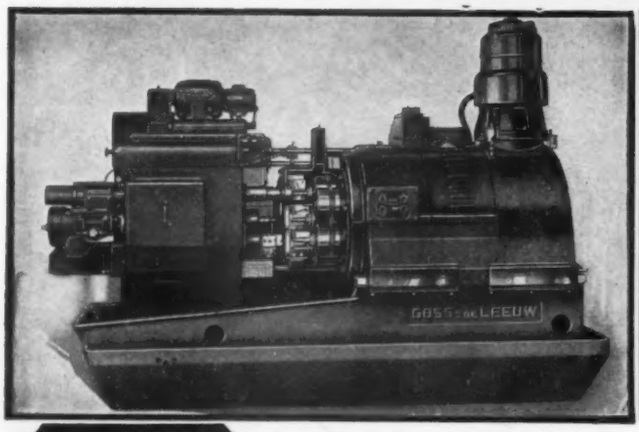

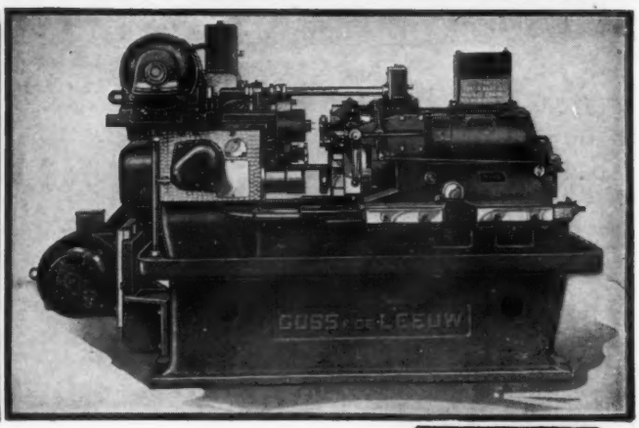

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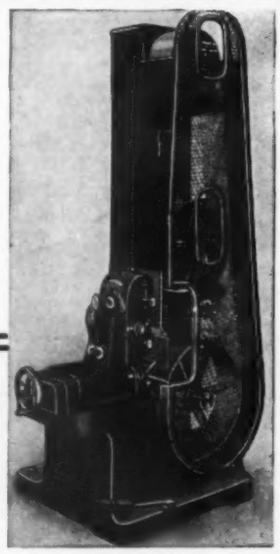

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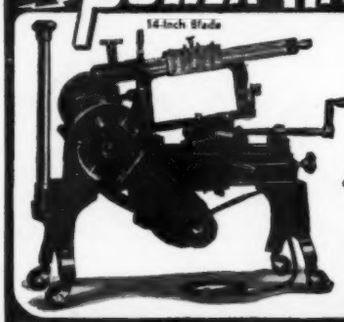

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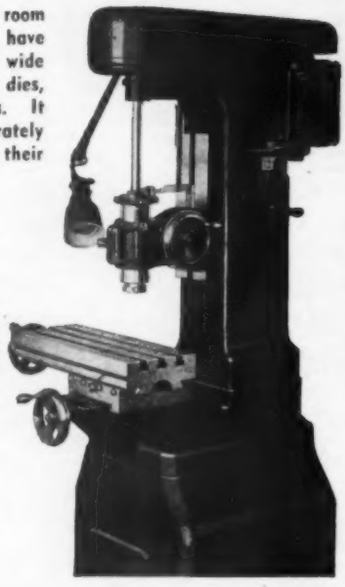

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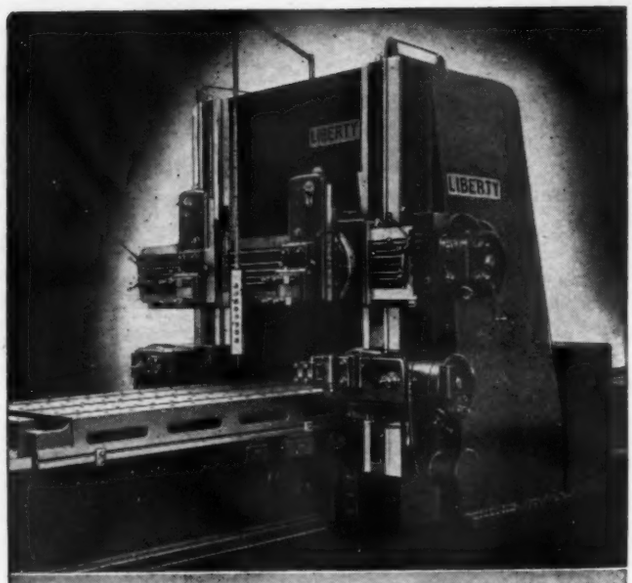

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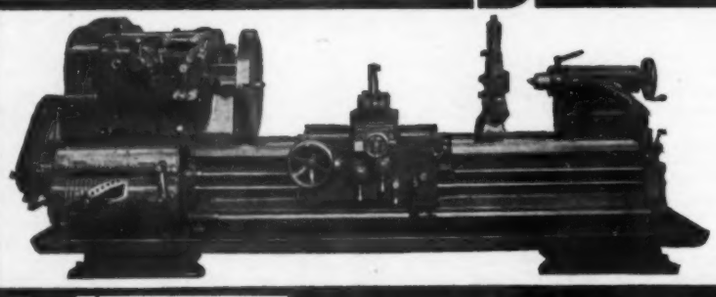

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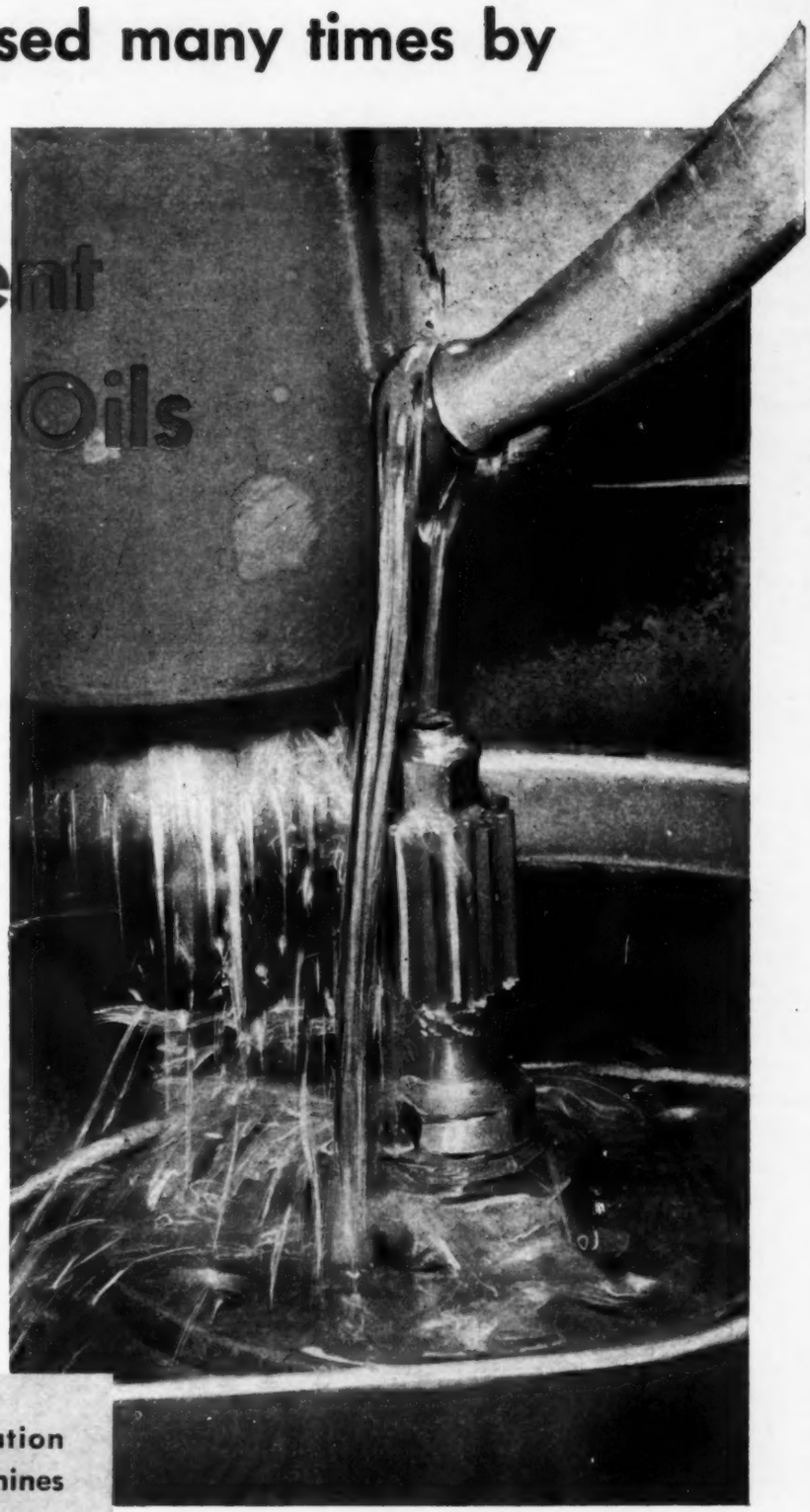

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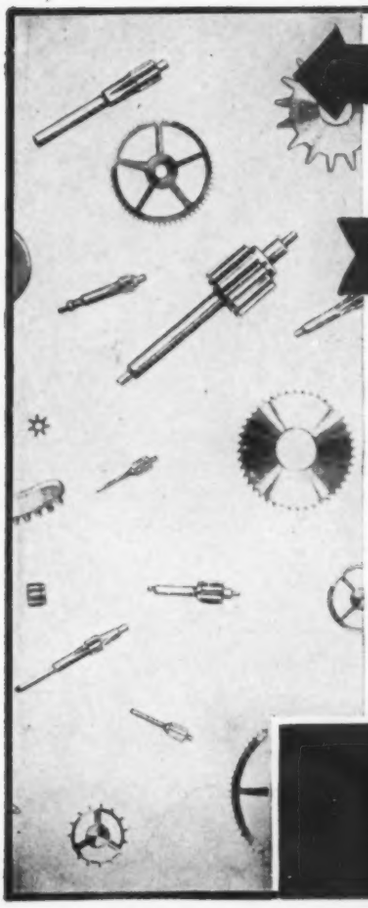

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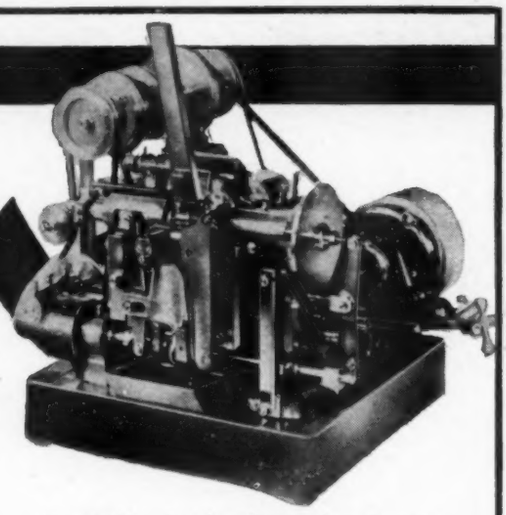

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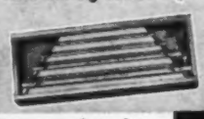
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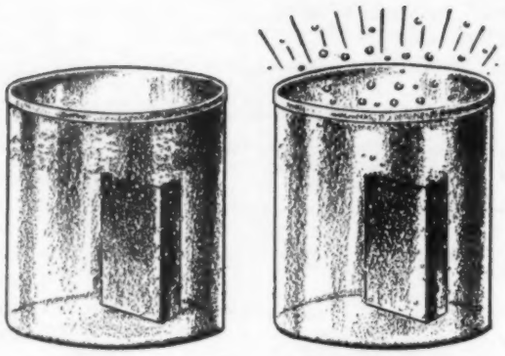

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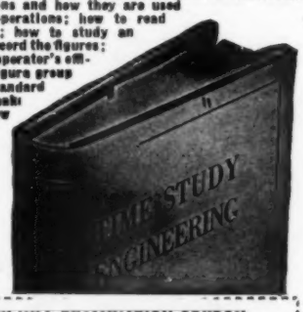

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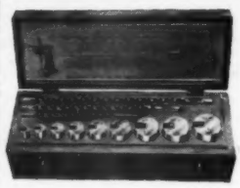

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Mexico — W. Picard, Mexico, D. F.

John H. Graham & Co., Inc. of New York City

THROUGHOUT THE REST OF THE WORLD

Threadwell

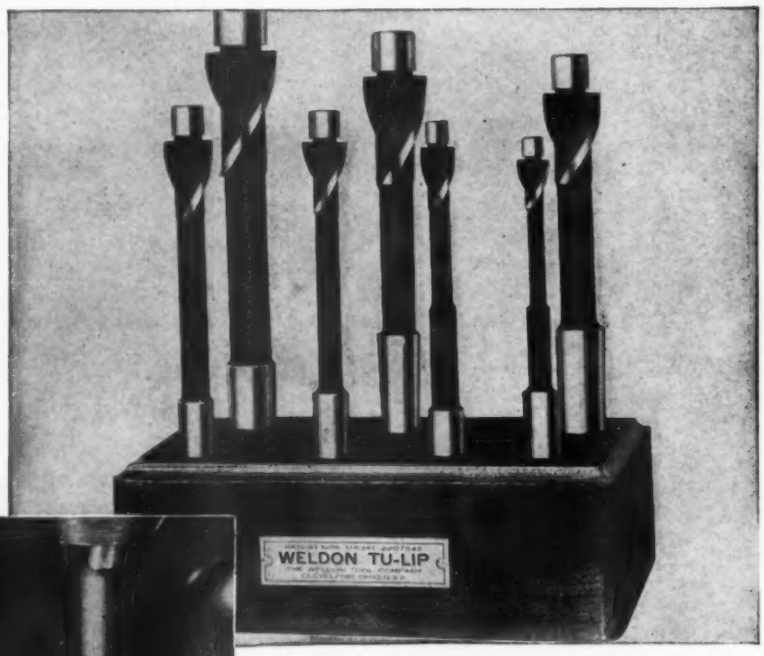
SINCE 1902

"TAPS OF DISTINCTION"

THREADWELL TAP AND DIE COMPANY • GREENFIELD, MASSACHUSETTS, U. S. A.

YESTERDAY'S PIONEER • • • TODAY'S LEADER

WELDON "TU-LIP" COUNTERBORE *for* FAST FREE CUTTING



As the name implies, the WELDON "Tu-Lip" Counterbore has only two cutting lips or flutes. This feature, together with the fast spiral, makes the "Tu-Lip" the fastest, freest cutting counterbore on the market.

Tool room service also is greatly reduced because there are only two cutting lips to grind and it will cut much longer between sharpenings. Breakage due to clogging is prevented because this improved cutting tool provides more than ample chip room. Furnished singly in sizes desired or in convenient wood block sets as illustrated.

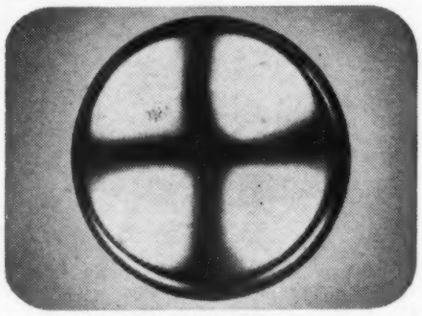
Write for sizes and prices.

THE WELDON TOOL CO. *Cleveland 4, Ohio*

3000 WOODHILL ROAD

THE *Safest* EYES WEAR WILLSON SAFETY SPECTACLES

• Accurate fit for every worker—whatever his type of face—is easily possible with Willson's 20 sizes. Remember, correct fit is necessary for maximum safety. For day-long comfort, too.



• SUPER-TOUGH* lenses ward off impact hazards. Each lens is thoroughly tested. Examples: Polariscope test for uniformity of heat treatment; Federal drop-ball test for impact resistance.

• Choose from two styles. "A", without sideshields, "AS", with sideshields, (plastic, Sonite, leather, or wire screen). For glare protection, too, specify lenses in Willsonite green.

WILLSON 75 YEARS

For help with your eye-protection problems, get in touch with your Willson distributor or write direct to Willson Products, Inc.

*T. M. Reg. U. S. Pat. Off.

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PRODUCTS INCORPORATED

Established 1870

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The Leader in it's field

MODERN SELF-OPENING STUD SETTERS

Used by practically every automobile, truck, tractor, diesel engine manufacturer and others with studs to set in quantity.

As the action of the tool is positive and automatic, it can be operated in any position with either air or electrically operated portable tools. It can also be used in a drill press, where it is possible to drill and tap the holes and set the studs in successive operations.

The three simple MODERN steps to speed, economy, and convenience in stud setting are illustrated at the right.

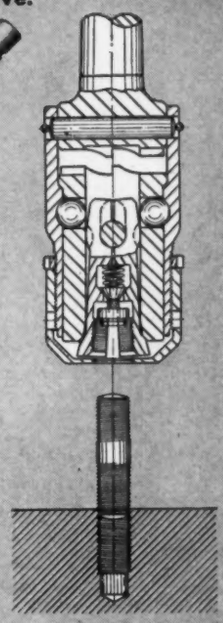
At the top . . . jaws open to take the stud.

Middle . . . driving position, jaws locked on stud.

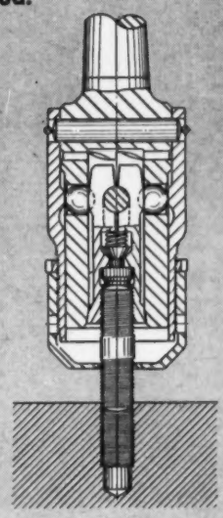
At the bottom . . . stud driven to full depth. The stop collar contacts the work and releases the clutch. Lifting the tool opens the jaws.

The tool revolves in one direction, no reversal, for the complete job.

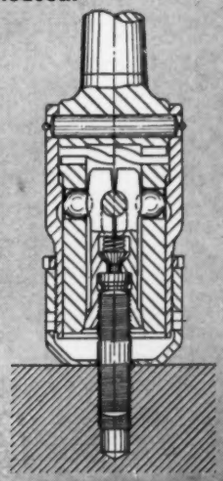
Tool brought to position over stud, about to begin drive.



Start of the drive, with tool engaged on the stud.



Drive completed, with clutch released.



Write for detailed information on the Modern Stud Setter. You will be interested in how and why it provides a proved means for stepping up your production.

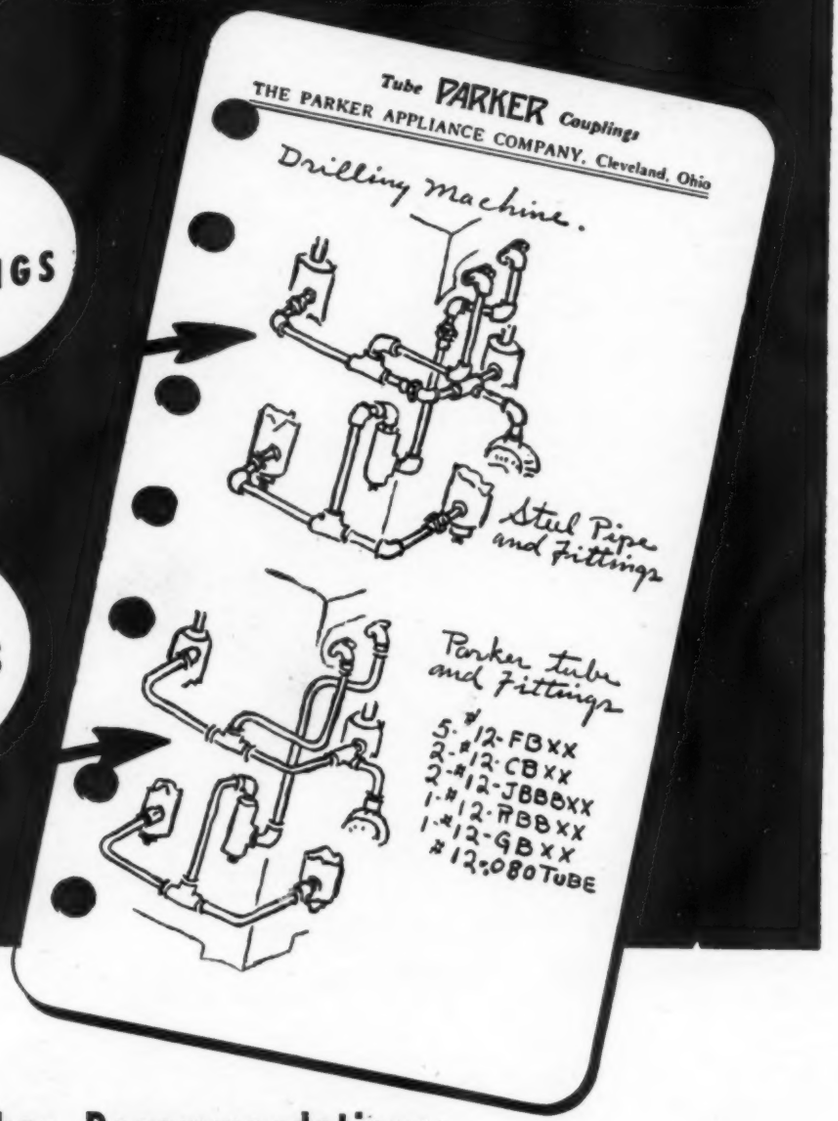
MODERN TOOL WORKS

DIVISION OF
CONSOLIDATED MACHINE TOOL CORPORATION
ROCHESTER 10, NEW YORK

PROOF FROM A PARKER ENGINEER'S NOTEBOOK

22 PIPE FITTINGS
OLD METHOD

11 PARKER TUBE COUPLINGS
RECOMMENDED PARKER METHOD



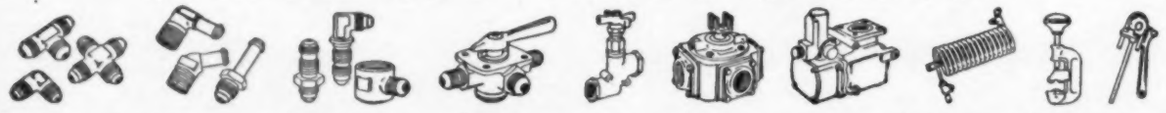
Advantages of Parker Recommendations:

- Streamlined flow, free from obstructions. No pockets to cause turbulence. Less pressure drop; capacity and pressure requirements reduced.
- Fewer joints and connections — to reduce leakage, even under high pressure vibration, shock, fluid hammer, surge or accidental abuse.
- Compact, spacesaving, neat and simplified installation, especially in tight places — yet all parts are accessible for quick, easy installation and service.

• • •

We've engineered Fluid Power installations for many people — to bring them these advantages, under a wide range of exacting conditions. May we do the same for you? Let's talk it over.

THE PARKER APPLIANCE CO.
CLEVELAND • LOS ANGELES



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Immediate Delivery

HIGH SPEED STEEL, STRAIGHT SHANK

TWIST DRILLS

EXTRA LENGTH

9″ CUTTING FLUTES—12″ LONG DRILLS

SIZE INCHES	LENGTH OVERALL INCHES	LENGTH FLUTES INCHES	PRICE EACH NET	SIZE INCHES	LENGTH OVERALL INCHES	LENGTH FLUTES INCHES	PRICE EACH NET
1/8″	12	9	$1.50	21/64″	12	9	$2.25
9/64″	12	9	1.50	11/32″	12	9	2.25
5/32″	12	9	1.50	23/64″	12	9	2.50
11/64″	12	9	1.50	3/8″	12	9	2.50
3/16″	12	9	1.50	25/64″	12	9	2.75
13/64″	12	9	1.60	13/32″	12	9	2.75
7/32″	12	9	1.60	27/64″	12	9	3.00
15/64″	12	9	1.75	7/16″	12	9	3.00
1/4″	12	9	1.75	29/64″	12	9	3.25
17/64″	12	9	1.85	15/32″	12	9	3.25
9/32″	12	9	1.85	31/64″	12	9	3.25
19/64″	12	9	2.00	1/2″	12	9	3.25
5/16″	12	9	2.00				

HIGH SPEED STEEL, TAPER SHANK

TWIST DRILLS

EXTRA LENGTH

SIZE INCHES	LENGTH OVERALL INCHES	LENGTH FLUTES INCHES	PRICE EACH NET	SIZE INCHES	LENGTH OVERALL INCHES	LENGTH FLUTES INCHES	PRICE EACH NET
17/32″	15	12	$6.50	27/32″	15	12	$11.50
9/16″	15	12	7.00	7/8″	15	12	12.00
19/32″	15	12	7.50	29/32″	15	12	12.50
5/8″	15	12	8.00	15/16″	15	12	13.00
21/32″	15	12	8.00	31/32″	15	12	14.00
11/16	15	12	8.25	1″	20	15	16.00
23/32″	15	12	8.50	1-1/16″	20	15	17.00
3/4″	15	12	8.50	1 1/8″	20	15	18.00
25/32″	15	12	9.50	1-3/16″	20	15	20.00
13/16″	15	12	11.00	1 1/4″	20	15	22.00

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INC.

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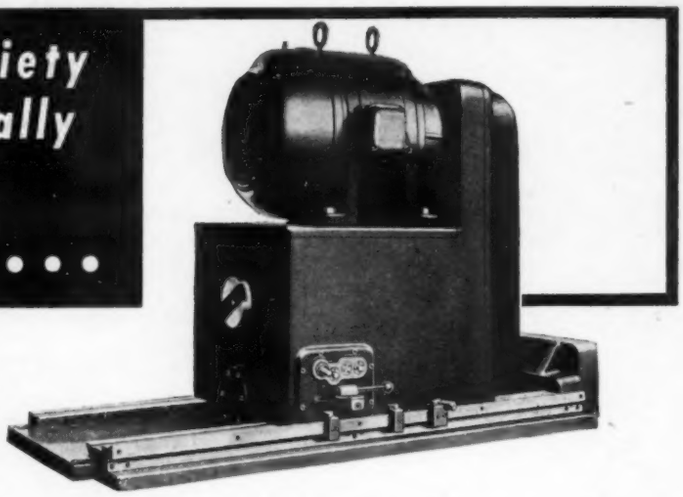
PHONE: CAnal 6-5575

You can produce a variety of parts more economically with a HOEFER UNIT...



★ These units can be used either as individual units, in groups, or in combination with other machines doing boring or allied operations while the machine performs its functions. These units can also be made into way machines for the most economical production of a variety of parts. They can also be equipped with HOEFER Multiple Spindle Heads with spindles for various operations in multiple.

These units may be operated in any position to suit the requirements of the work, horizontally, vertically, or at an angle — meeting every production drilling need at a fraction of the cost of special drilling equipment. When several of these units are operated in conjunction with one another they may be individually controlled or operated with remote group control as desired.

HOEFER Self-Contained Hydraulic Feed Units give you production flexibility. They are never obsolete and can be used with perhaps a new base in the construction of a new drilling set-up for the new part. These units therefore are ideal equipment to have for those now producing war and other vital equipment and who will change over to peace time products with war's end.

Consult with us now — let us show you exactly what a HOEFER Unit will do for you in terms of equipment and production savings.

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A SWING OF A LEVER— AND IT'S ON OR OFF

NO WIRES-NO HEATING-NO OPERATING COSTS

Suited for use on machine or bench. Rectangular and Rotary Models. Catalog on request.
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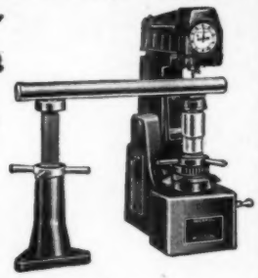
Hardness Testing Problems Always Suggest

"ROCKWELL" HARDNESS TESTER

(or for micrometric tests the "TUKON" Tester)



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MECHANICAL INSTRUMENT CO. INC.
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STANDARD **US** SINCE 1915

HEADS

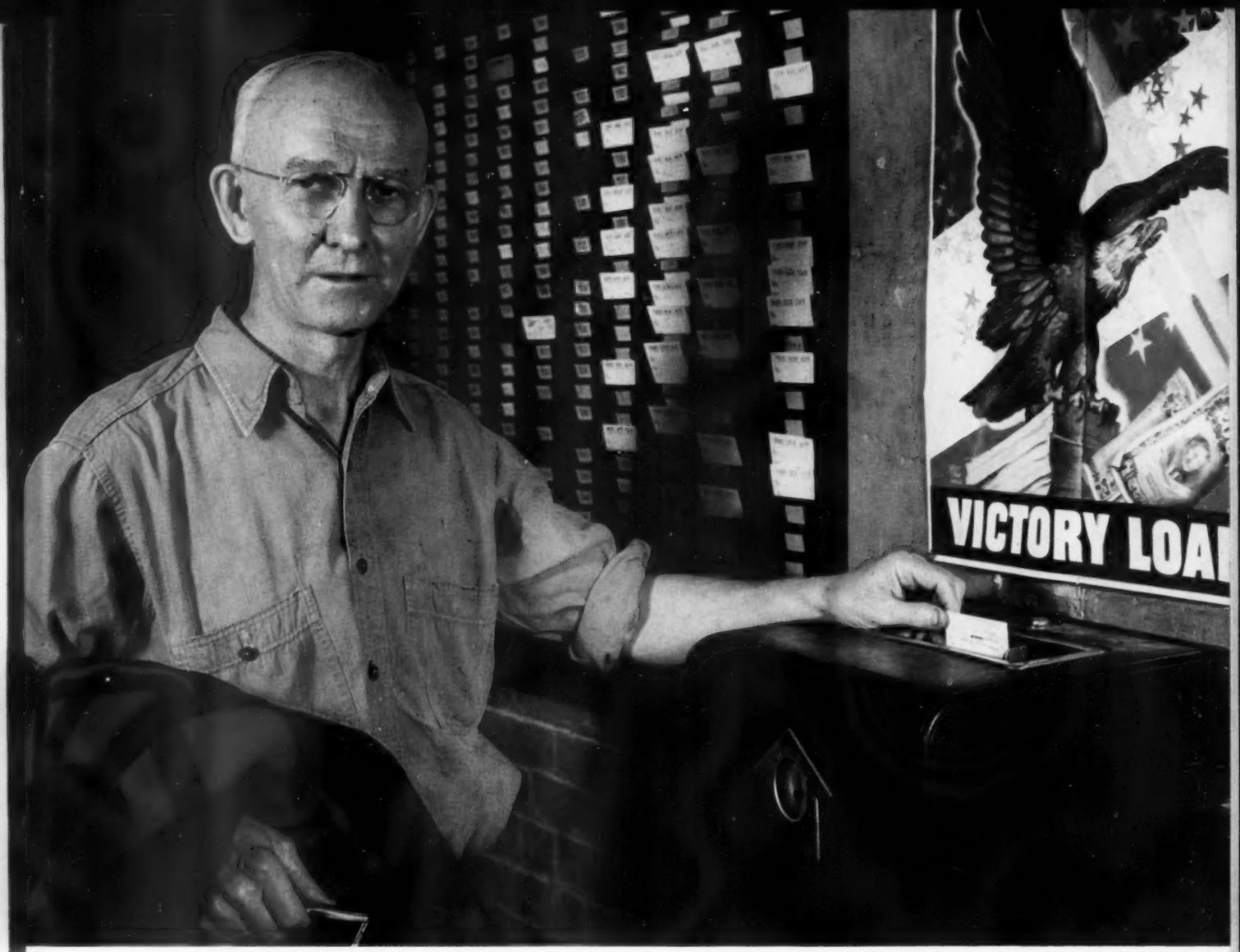
All Types of Fixed Center

DRILLING TAPPING & BORING HEADS

Four Spindle Head. All Spindles Adjustable for equally spaced holes.

FIVE TYPES, 56 SIZES, ADJUSTABLE DRILL HEADS

UNITED STATES DRILL HEAD CO., CINCINNATI 4, OHIO



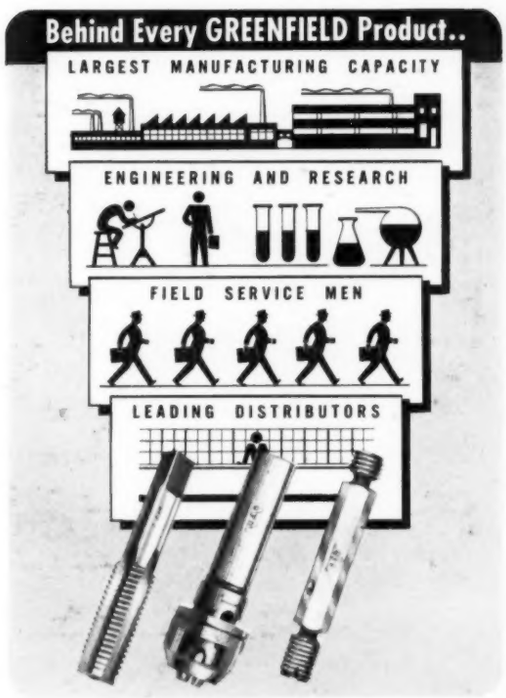
Not 62,940 hours for nothin'!

I figure I've punched in over 62,940 hours for GTD.

Maybe you fellows who buy threading tools don't realize it, but those hours mean something when you buy a tap, die or gage with the GTD mark on it. Those hours mean better workmanship – the result of years of learning by doing.

You might be interested to know that in the "Greenfield" organization there are 296 of us who have spent 20 years or more at our jobs – making high quality threading tools.

When you buy "Greenfield" – you buy precision. And precision takes practice.



GREENFIELD

GREENFIELD TAP and DIE CORPORATION

GREENFIELD, MASSACHUSETTS

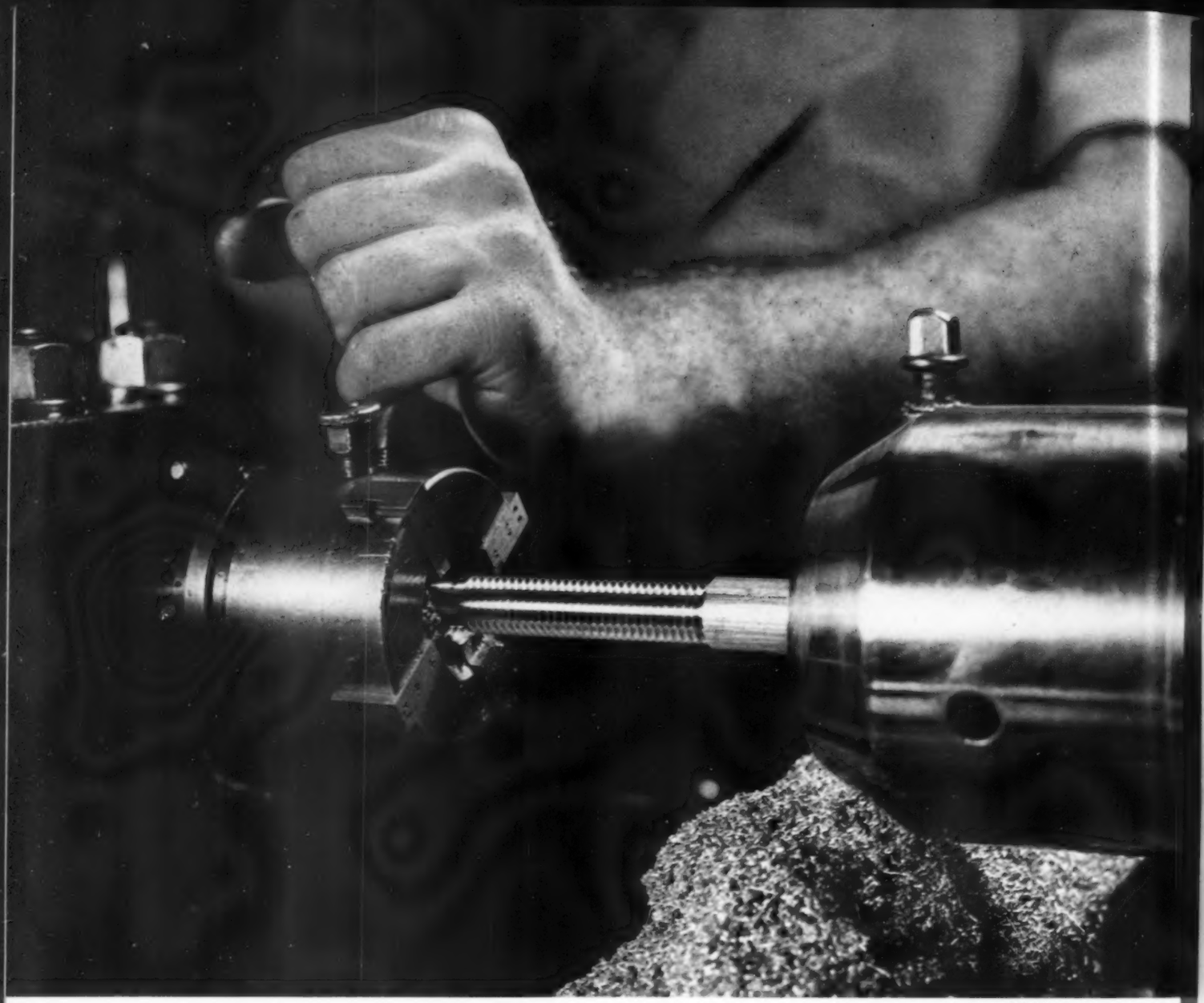


PHOTO COURTESY [illegible]

YOU BET — IT'S A GEOMETRIC!

This photograph might have been taken in any one of thousands of metal-working plants all over the world. It shows the dean of all Die Heads—the Geometric Style "D"—cutting $\frac{5}{8}$"-11 NC threads on an adjusting spindle for a precision steam control device. This simple, sturdy threading tool has been a favorite for over 50 years wherever metal is worked on a production basis. The particular Die Head illustrated is the $\frac{3}{4}$" Style "D" Geometric Die Head and easily cuts threads from $\frac{1}{4}$" to $\frac{3}{4}$" while the whole Style "D" line cuts threads from $\frac{1}{8}$" to $3\frac{1}{2}$".

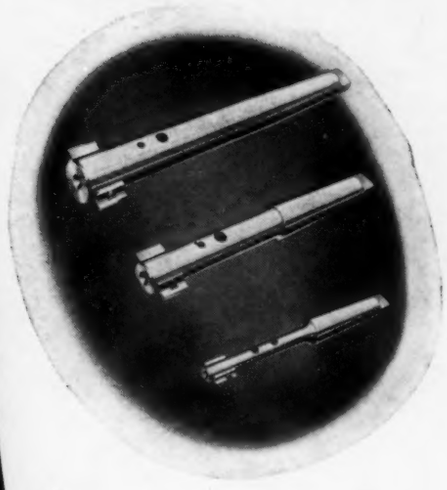
FOR NEARLY EVERY THREADING JOB — A GEOMETRIC!

If you have in mind a particular threading problem, we will be glad to have our engineers give you their recommendations, based on over a half century of specialization in this field. Why not let us send you the latest Geometric catalog?

THE
GEOMETRIC
TOOL COMPANY . . NEW HAVEN 15, CONN.
A Division of Greenfield Tap and Die Corporation

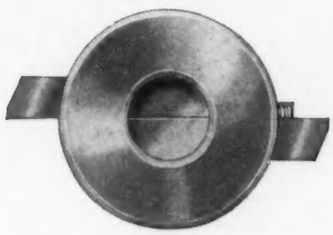
4 REASONS WHY MADISON REAMERS CUT TIME AND COSTS

The simplified design and operational features of Madison Production Reaming Tools will enable you to cut your reaming time and hole costs to the minimum. Easy to adjust, to maintain and always aligned, the free, smooth cutting action of Madison Reamers has provided the answer to industry's need for greater speed and economy in reaming operations. Check the four reasons for Madison efficiency listed below.



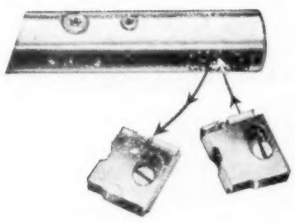
MIRROR-SMOOTH FINISH

The cutting blades of a Madison Reamer produce a mirror-like finish that in most cases does not require an additional finishing operation. Since Madison cutters are pre-sized, any number may be stored in a crib. The Madison one-screw adjustment feature insures that both blades always cut, by eliminating possibility of unequal cutter blade expansion.



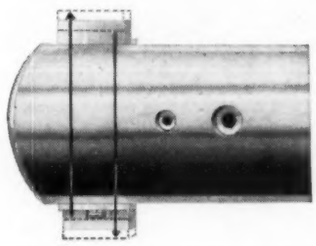
BETTER CHIP CLEARANCE

Because Madison Reamers have no multiple inserted blades, there is more room for chip clearance and circulation of coolant. Thus, danger of clogging and resultant overheating is eliminated, and shrinking or tapering of the hole prevented. Further insurance against hole distortion is provided by Madison's freer cutting action, which permits work to be held very lightly. This makes Madison Reamers ideally suited to the machining of the new, lightweight metals.



INTERCHANGEABILITY

Since Madison cutters are pre-sized, they are interchangeable in Madison bars. A sharp cutter can be inserted in a Madison bar in a matter of seconds without disturbing the original set-up. Keeping a sharp cutter in operation at all times assures more continuously uniform work and the holding of required tolerances. The two-bladed Madison cutter will naturally require less maintenance time.



CONTROLLED FLOAT

Because the Madison cutter is floated in its bar at the exact point where the cutting action takes place, float can be better controlled and indicated for greater uniformity on long-time production jobs. Chances for bell mouth and bar wobbling are eliminated. No special floating tool holders and chucks are necessary.

MADISON
MANUFACTURING COMPANY
DEPT. A-6 MUSKEGON, MICHIGAN

Madisons are used for rigid or float reaming on lathes, drills, millers and special machines. Used on hard and soft metals and plastics. Write for the Madison catalog — lists complete lines, prices and grinding instructions.

Lapping Problems?

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U. S. PRODUCTS CO.
LAPPING COMPOUNDS

...solve your problem and prove their superiority at our expense!

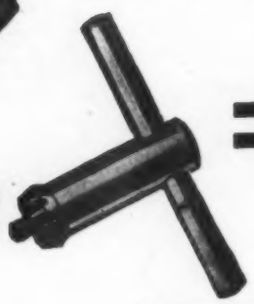
If you are precision lapping gauges, dies, tools or instruments by plate, machine or hand methods, you can now prove, to your own satisfaction, that U. S. PRODUCTS are *right* for these operations. You don't have to buy to try! Just for the asking, a trial box containing six, 1 oz. sample jars of U. S. PRODUCTS COMPANY Lapping Compounds will be sent postpaid.

This trial offer includes six grades of compounds, all fine abrasive grit sizes, best suited for a variety of precision lapping. A chart on the inside lid of the carton lists the compounds by grit size, relative hardness of abrasive, and gives general service recommendations.

We know that U. S. PRODUCTS will stand on their own merits. Get acquainted with these *finer quality* and *finer grit* lapping compounds now. Just write and ask for the trial carton.

UNITED STATES PRODUCTS CO.
518 MELWOOD ST., USPCO PITTSBURGH, PA.

Almond Drill Chuck



The Original Manufacturers of Drill Chucks

●

As Pioneers in their field, ALMOND THREE-JAW DRILL CHUCKS have played an important part in machine tool development. They were the first to be placed on the market more than seventy years ago.

Types and sizes are available to fit all machine tools and portable drills.

Write for complete information.

T. R. ALMOND MFG. CO.
ASHBURNHAM, MASS., U.S.A.

Straight Shank Subland Oil Hole Drill

Morse Taper Shank Subland Oil Hole Drill

BEFORE THE WAR
... DURING THE WAR
... AFTER THE WAR

Continually striving for better *customer good will* by offering the best possible in cutting tools.

Make Detroit Reamer and Tool Company YOUR HEADQUARTERS FOR:

Subland Drills
Subland Reamers

***Subland Oil Hole Drills**
Subland Oil Hole Reamers
Oil Hole Drills
Circularity Relieved Reamers
Circularity Relieved End Mills

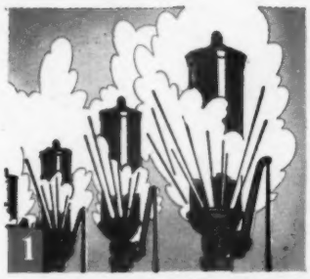
Combination Drill and Reamers
Special Reamers
Special Drills
Special Center Drills
Special Counterbores
Special Countersinks
Circular Form Tools
Flat Form Tools
* Illustrated

Special Tools To Your Specification

Write for QUOTATION

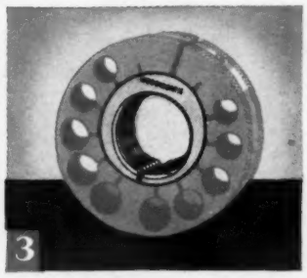
DETROIT REAMER & TOOL CO.
2830 E. 7-Mile Road
Detroit 12, Mich.

Holy Smokes! They've done it again!

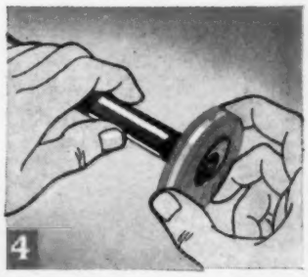


Blow all the whistles! They've done it again!

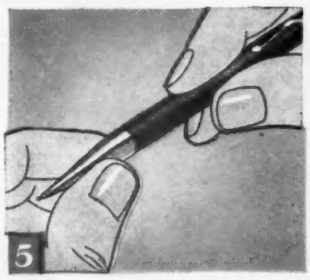
Blast out a fanfare for a great new Woodworth invention!



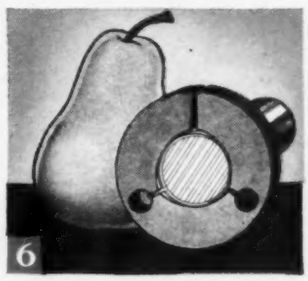
It's the Woodworth Adjustable Thread Ring Gage.



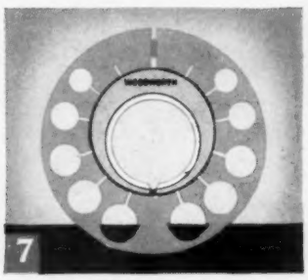
Thread ring gages check the O.D. of threaded parts.



Adjusting 'em as they wear down saves time and money.

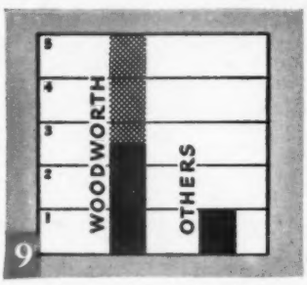


But old types get pear-shaped —lose accuracy—wear out fast.

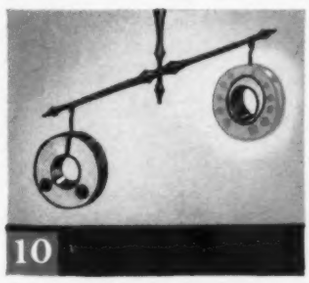


This Thread Ring Gage adjusts perfectly — *stays round.*

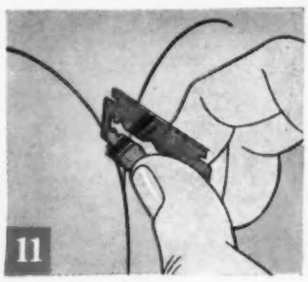
Never gets out of line when dropped or thrown about.



Equal distribution of wear increases life 2½ to 5 times.



Light weight reduces operator fatigue — increases sensitivity.



It's amazingly accurate . . . ideal for hair-splitting work.

Woodworth's New Thread Ring Gage is an all-time champion!

Another Woodworth contribution to production

THE NEW Adjustable Thread Ring Gage, another revolutionary Woodworth instrument of accuracy, is now available to industry!

Employing an entirely new principle of design, and proven mathematically correct by actual tests, this gage assures roundness through the maximum range of adjustment.

Check these
Five Important Advantages

1. *Greater Accuracy and Stability.* Stays round with adjustment. Threads held in alignment of thread helix angle with adjustment. Will not reject parts that should pass inspection.

2. *Longer Wear Life.* Equal distribution of wear over the full thread circumference, throughout the entire range of adjustment, increases wear life 2½ to 5 times.

3. *Less Weight.* Aluminum alloy outer body halves the weight to greatly reduce operator fatigue and increase sensitivity.

4. *Positive Identification.* Green outer body for GO GAGE and red for NOT GO GAGE saves time for operator.

5. *Positive Adjustment.* Cannot be thrown out of adjustment by ordinary blows or falls that change setting of conventional gages.

You can speed up production and decrease gaging costs on your thread inspection operations with this amazing instrument! Write for completely illustrated folder 46-R.

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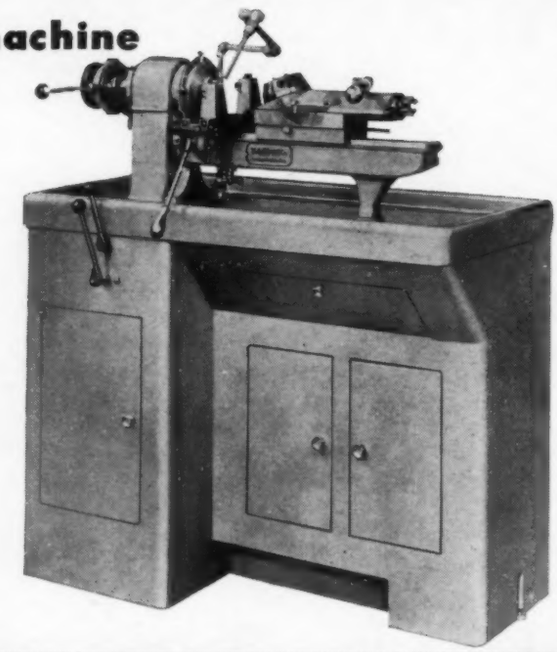
N. A. WOODWORTH CO., SALES DIVISION, 1300 E. NINE MILE ROAD
DETROIT 20, MICHIGAN

PRECISION GAGES
PRECISION MACHINED PARTS
DIAPHRAGM CHUCKS—SPECIAL TOOLS
ADJUSTABLE CLAMPING JIGS

SAVINGS

the dollar sign is on the work...

not on the machine



for example...

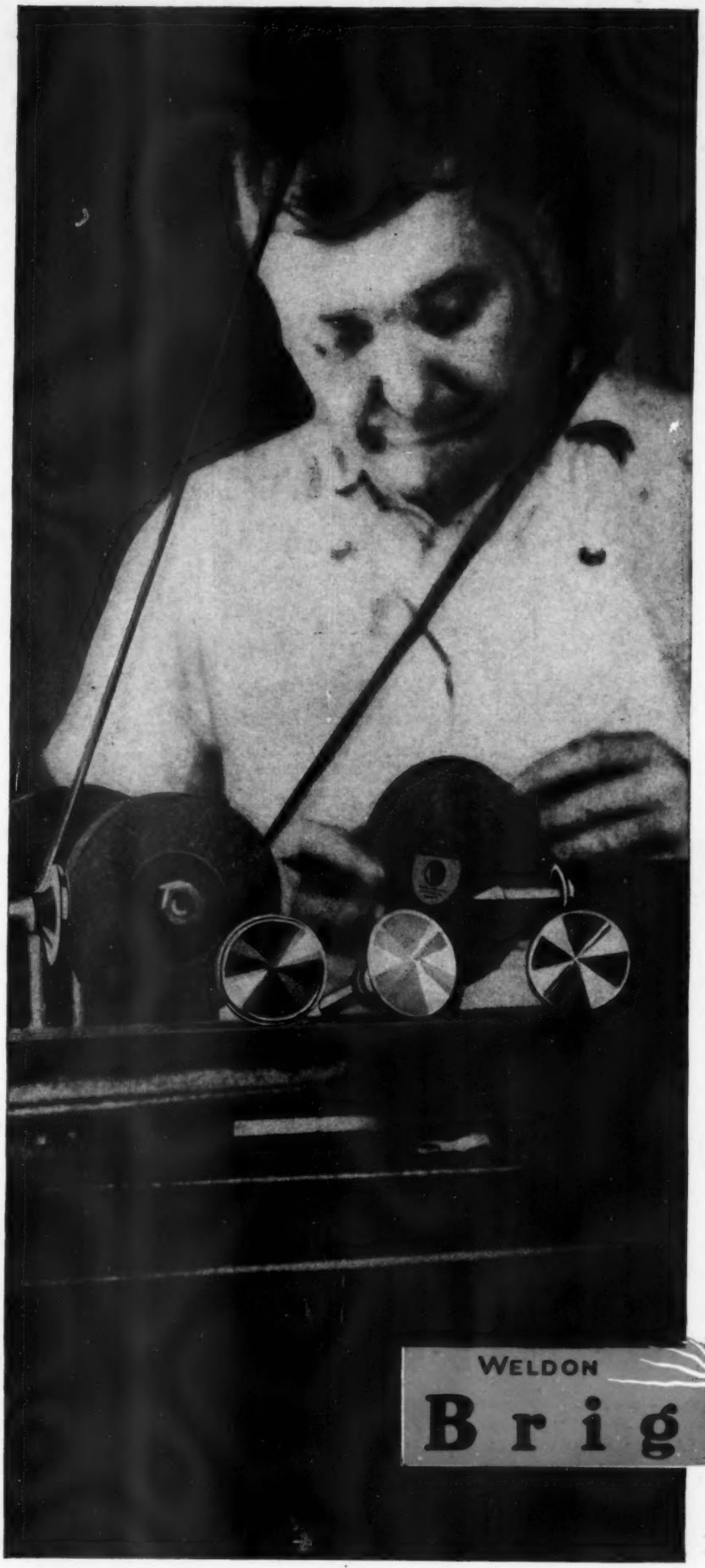
One manufacturer was dissatisfied with a lathe used for mass-producing parts requiring close tolerances. Wade engineers recommended a Wade Hand Screw Machine — it did the job faster and more easily, and to specified tolerances. The less expensive Wade was the answer.

Another manufacturer used a cheaper machine with unsatisfactory results. The Wade Hand Screw Machine, although higher in cost, paid for itself in less than 3 months by producing more, in less time, to a higher degree of accuracy.

The cost of the machine is part of the cost per piece produced. Wade engineers, working on this basis, can give you assistance in choosing the right machine for your small parts production. Call on them.

Wade

The Wade Tool Company
53 River St., Waltham 59, Mass.



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FINISHING "FINESSE"

—Improves Product-Quality
—Cuts Working Time

To the consumer, a Brightboy-finished product STANDS OUT because of its superior quality; to you it represents LOWER PRODUCTION COST.

Brightboy's resilient rubber binder, working simultaneously with the abrasive, burrs, finishes and polishes in one operation—bridging the gap between the grind and the buff.

Your dealer will give you Brightboy literature explaining how; also Brightboy prices and catalog. Your Brightboy service man will give you work-saving, product improvement suggestions.

Wheels Blocks Sticks Rods

in 3 TEXTURES

BRIGHTBOY STANDARD

Favorite for burring, finishing and polishing on the widest variety of metals and metal parts.

BRIGHTBOY FINE-TEX

Smoother, finer texture for work on softer metals, producing special finishes and for applications where the coarser wheel might not be suitable.

BRIGHTBOY TUFF-TEX

Tougher texture, for finishing hard metals. The tougher binder accents the abrasive action, yet retains the soft rubber cushion, finishing and pre-polishing in one operation.

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BRIGHTBOY INDUSTRIAL DIVISION
WELDON ROBERTS RUBBER CO.
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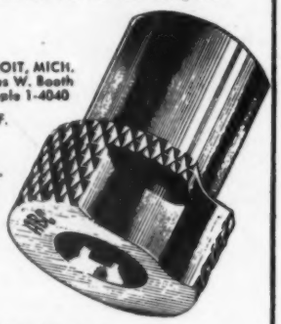
Your KEY to MASS PRODUCTION
Will Speed up Drilling and Lower Costs

A. S. A. STANDARD
PRECISION DRILL JIG BUSHINGS

Standard sizes and styles in stock for prompt delivery. Write for catalog showing table of standard sizes of bushings with price list and other valuable information for the tool designer.



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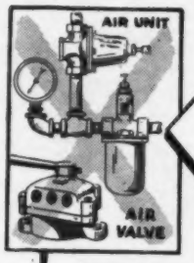

1 Lehigh-MARTON COMBINATION UNIT does the work of 4 old fashioned units

HERE IS A REAL ADVANCE IN AIR CONTROL EQUIPMENT

LEHIGH'S OWN large organization with its modern foundry plants and many acres of automatic tools, is the inspiration and proving ground for this fine new air control equipment. LEHIGH knows the need from wide experience — and stands ready to share its many major air control developments with other progressive organizations. Inquiries are invited.

Lehigh-MARTON
★COMBINATION VALVE — as illustrated
★DELAYED ACTION VALVE — for single control of multiple operations
★PACKLESS, QUICK OPENING HAND OPERATED VALVE — for 4-way operation

Ask for Bulletin AM101

Lehigh-MARTON
Combination Unit
MODEL 3-MA2
for 2-3-and 6 way action.
Combines . . . VALVE, GAUGE, REGULATOR, LUBRICATOR AND STRAINER
Use up to 200 lbs. Pressure

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ADJUSTABLE
PATS. PENDING

Any Hole Pattern

Drill 6 Holes at One Stroke— Adjustable for any Pattern!

Your drill presses equipped with adjustable MULTI-DRILL heads will

- **Reduce costs thru multiplying your present drill press production**
- **Conserve valuable floor space in your shop or departments**
- **Reduce your equipment investment**
- **Often save their cost on the first job**

The MULTI-DRILL attaches conveniently to most ½" drill presses. Its six radially adjustable spindles are quickly set to any hole pattern within 5" circle—11/16" minimum centers. Standard capacity 3/32" to 17/64" drills. Many modifications are available for your special applications at slight additional cost.

Write today for circular.

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You can get ACCURATE CROSS-CENTER DRILLING *and many varied uses*

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A PRECISION WORK HOLDING FIXTURE
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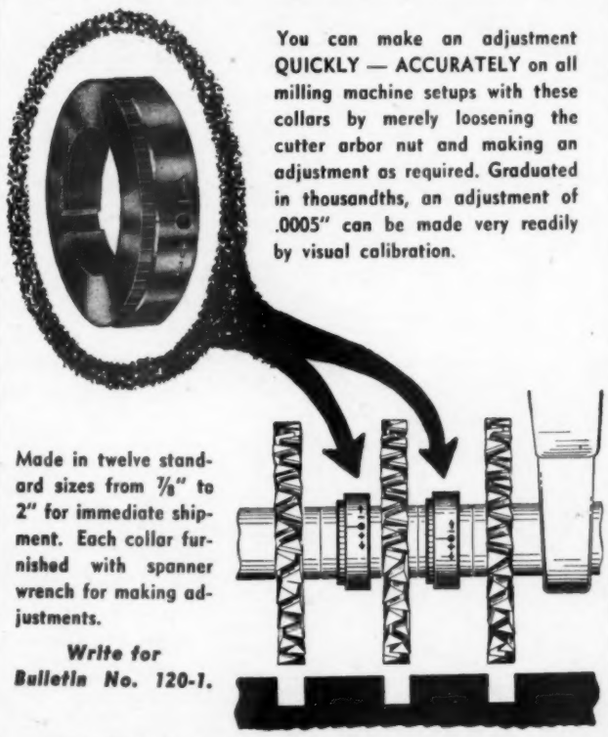
MICROMETER ADJUSTMENT

on side milling cutters and gang milling setups with Dayton Rogers Micrometer Adjustable Spacing Collars



You can make an adjustment QUICKLY — ACCURATELY on all milling machine setups with these collars by merely loosening the cutter arbor nut and making an adjustment as required. Graduated in thousandths, an adjustment of .0005" can be made very readily by visual calibration.

Made in twelve standard sizes from ⅞" to 2" for immediate shipment. Each collar furnished with spanner wrench for making adjustments.

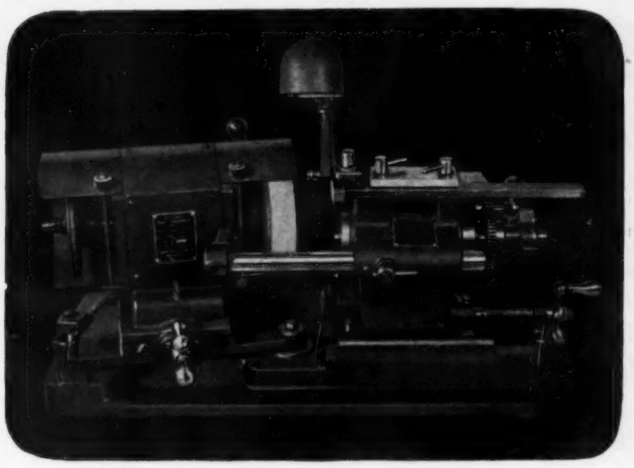
Write for Bulletin No. 120-1.

DAYTON ROGERS MANUFACTURING CO.
MINNEAPOLIS 7 MINNESOTA

EDWARD *Blake* COMPANY

634 COMMONWEALTH AVE., NEWTON CENTRE 59, MASS.

So Many More Holes per Tap in So Few Minutes on the BLAKE TAP GRINDER



MULTIPLYING TAP LIFE—*ten and more times*—is the *specialty* of the Blake Tap Grinder. It provides a rapid, low-cost method for accurate sharpening of taps on the chamfer.

The BLAKE removes the dull material from the chamfer *and—in the same operation*—grinds the necessary clearance behind the *new* and *sharp* cutting edges.

Taps kept sharp on the Blake maintain size and thread form over a long useful life. Many users report bonuses of thousands of extra holes from every tap kept sharp on the Blake Tap Grinder. With the BLAKE you can sharpen both right- and left-hand taps—*without* special gearing or fixtures. You can sharpen taps with 2, 3, 4, 5, 6, 8 or 10 flutes. Capacity is from No. 0 to 2 inches. We invite your investigation of this *modern* method of prolonging tap life.

See this machine and the complete line of Blake equipment at the A. S. T. E. Show in Cleveland, April 8-12.

Please send me Bulletin No. 544 which describes the Blake Tap Grinder in detail. A.M.

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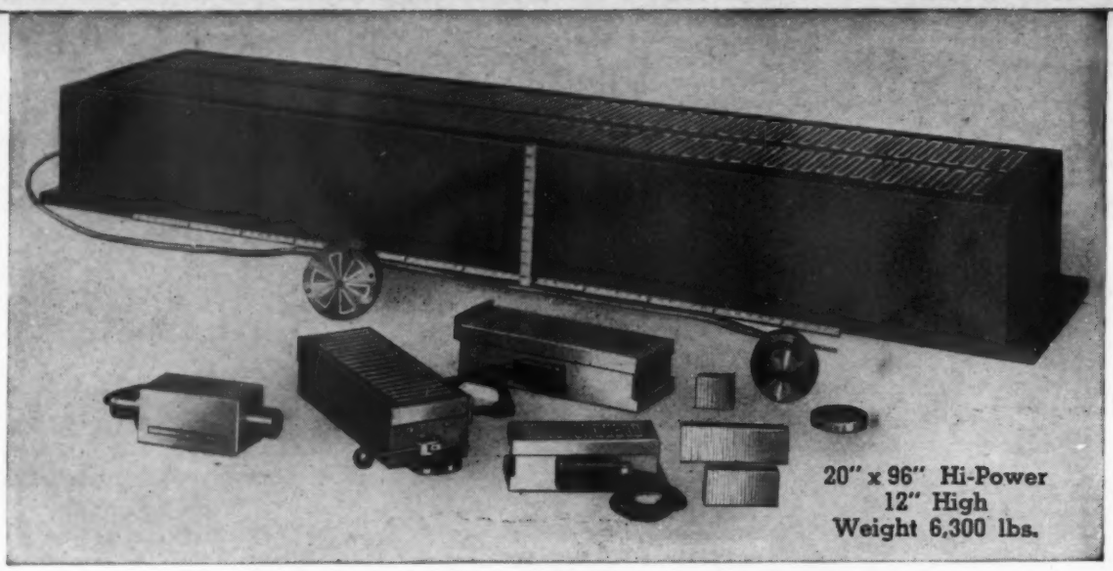
BLAKE TAP GRINDERS—FILTAIRE PORTABLE DUST COLLECTORS—AMERICAN TOOL HOLDERS—BLACK DIAMOND PRECISION DRILL GRINDERS—WALTHAM CUTTER SHARPENERS—HAGER CARBIDE TOOL GRINDERS



20" x 96" Hi-Power
12" High
Weight 6,300 lbs.

WHAT IS YOUR PROBLEM?

- The above display illustrates the diversified demand for WALKER CHUCKS.
- Increase your Productive Efficiency by the use of WALKER MAGNETIC CHUCKS.
- Less fatigue on the part of your operating personnel.
- Submit your problems to WALKER engineers for successful solution.

O. S. WALKER CO., INC.

100 ROCKDALE STREET - WORCESTER, MASSACHUSETTS

Makers of Rectangular, Swivel and Rotary Magnetic Chucks. Also Permanent Chucks.

ERRINGTON MECHANICAL LABORATORY

TAPPING CHUCKS

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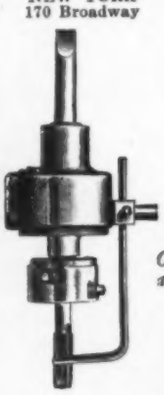
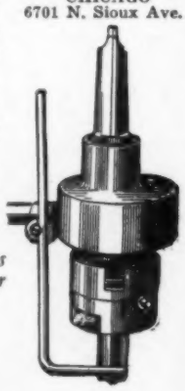
170 Broadway

CHICAGO
6701 N. Sioux Ave.

Size	Taps Exact Size	
No. 00 H.S.	Up	to 1/4"
" 00	1/8"	5/16"
" 0	5/16"	1/2"
" 1	5/16"	3/4"
" 2	3/8"	1 "
" 3	5/8"	1 1/4"
" 4	3/4"	1 1/2"
" 5	3/4"	2 "

Our High Speed Tappers are Super-Sensitive for Small Tapping





Style B Positive Stop Holds Work Down

Style C Graduated Adjustable Safety Friction

DRILL PRESS TURRET

Style D-E with Quick-Change Tool Holders to Drill, Tap and Set studs, etc., without moving work, or stopping or reversing machine. Individual friction adjustment in each tap-holder. If required.

Also, Opening Die-Heads; Opening Stud-Setters; Friction Screw-Drivers and Nut-Setters, etc.

LUERS

Patented Cutting Off Tool Holders
Patented Cutting Off Blades

ONLY the PATENTED construction of LUERS cutting off BLADES permits normal expansion of bursting chips — MEANS MAXIMUM CUTTING EFFICIENCY

Manufactured By
J. Milton Luers — 12 Pine St. — Mt. Clemens, Mich.
Produced under License Issued by John Milton Luers Patents Inc.

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BETTER, FASTER HOLE FINISHING

HELICAL TAPER PIN REAMERS

Scientifically made of selected steel under modern processes. Long lived, economical, accurate. Details on request.

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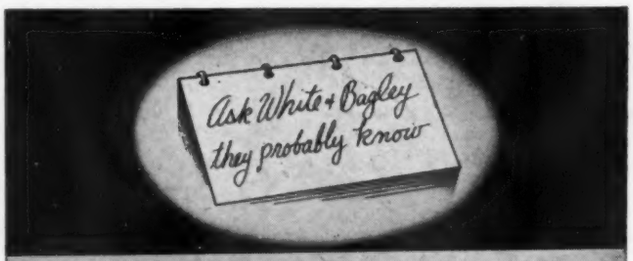
MANCHESTER, CONN.

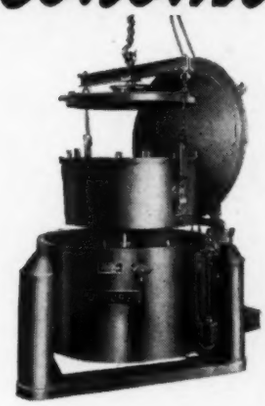


ECONOMY Grinding and Cutting Oils and Lubricants for Every Metal-Working Purpose

THE WHITE & BAGLEY COMPANY
WORCESTER, MASSACHUSETTS

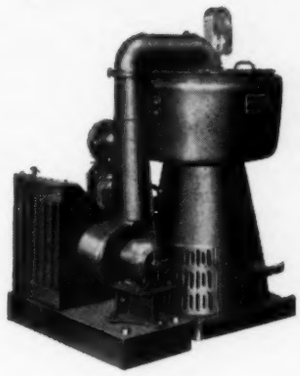
Spin off OIL, SOLVENTS, EXCESS SPELTER, ETC. FROM YOUR SMALL METAL PIECES

faster . . . more economical



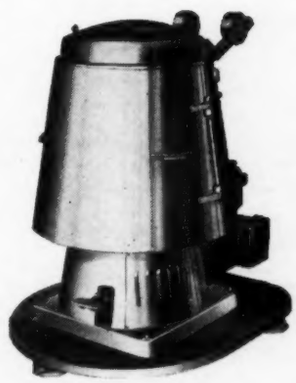
CHIP WRINGERS

Tolhurst Chip Wringers are available in two types. The "Solid Curb" is available with a 20" or 26" basket. Capacity 1¼ cu. ft. in 20" and 2½ cu. ft. in 26". Equipped with anti-friction bearings. The "Center-Slung" model is a heavy duty open-top wringer. Basket diameters are 40" and 48". Capacity 8.7 cu. ft. in 40" and 14.8 cu. ft. in 48". Basket suspension principle permits operation with unbalanced loads. Approved safety features.



METAL DRYERS

Drying small metal articles with Tolhurst Centrifugal "Metal Dryers" is standard practice. Parts to be dried are placed in a removable perforated basket. Centrifugal force and hot air dry the load in two to three minutes. Eliminates use of sawdust. Standard basket sizes: 20" and 26". Dump bottom basket saves labor, speeds drying. Available with vertical motor drive. Equipped with anti-friction bearings and approved safety devices.



GALVANIZERS

Equally effective for tinned or galvanized parts. "Spins off" excess spelter from batches of small parts in as little as two seconds. Coating is regulated by accelerating rate.

Baskets are removable. Standard size basket 16" diameter. Outer casing of machine is constructed so that "slingings" may be quickly removed for remelting. Can be furnished with wound rotor motor for varying acceleration rates for light or heavy parts.

Tolhurst Centrifugals are backed up by more than 90 years' experience in the designing and building of centrifugals. Tolhurst Sales Engineers are conveniently located in principal cities. If you have a process problem that might be solved by centrifugal force, describe it in a letter. Write today! Address nearest district office.

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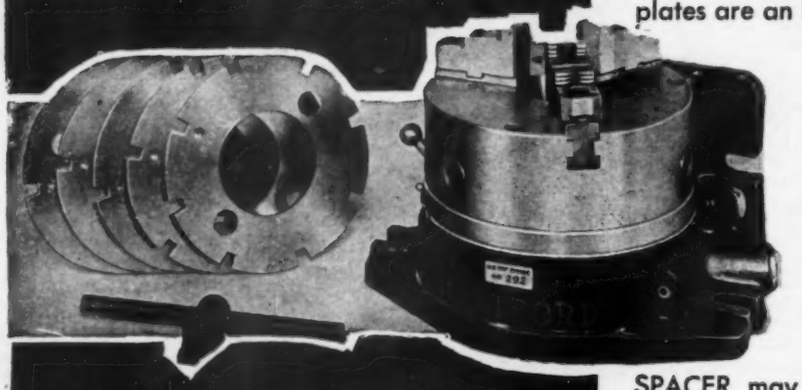
CHICAGO PHILADELPHIA ATLANTA DETROIT DALLAS MINNEAPOLIS LOS ANGELES

TOLHURST CENTRIFUGALS DIVISION

American Machine and Metals, Inc., East Moline, Illinois

The HARTFORD SUPER-SPACER



- *Modern, simple and Easily operated . . .*
- *Accuracy of indexing maintained at all times*

The standard SUPER-SPACER, as shown here, includes mask plates, reversible jaws, self-centering chuck and sliding handle chuck wrench. The mask plates are an important feature, because they eliminate all chance of error in indexing.

As shown, the HARTFORD SUPER-SPACER is adaptable to milling, drilling, grinding, slotting and jig boring. With attachments which are available for all standard SUPER-SPACERS, the device is adaptable to radial drilling, drilling spaced holes in a circle and many other operations. The fact that the SUPER-SPACER may be used in either a horizontal or vertical position is another reason for its outstanding versatility.

Ask for full information on the SUPER-SPACER—explore its many applications—and you'll quickly see its possibilities on your work.

The HARTFORD
SPECIAL MACHINERY CO.
Hartford 5, Conn.

USE
Fluid-motion
for modern form-dressing
ONE SETTING HANDLE CONTINUOUS MOTION

J & S Radii & Angle Dressers in the "Fluid-Motion" series are among the finest precision dressing instruments procurable. . . . regardless of cost. There is a standard model to fit most form-dressing requirements.

FEATURES

Fluid-motion dressing
.0001" accuracy
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7" & 14" wheel capacities
Large range yet compact
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477 MAIN STREET
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CARBIDE TIPPED
Consistent Quality
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HARDNESS TESTER

The *Scleroscope* is the only hardness tester that takes in the entire range from the softest to the hardest metals without any adjustments.

MODEL D-1 DIAL TYPE
Write for Circular!

THE SHORE INSTRUMENT & MANUFACTURING CO., INC.
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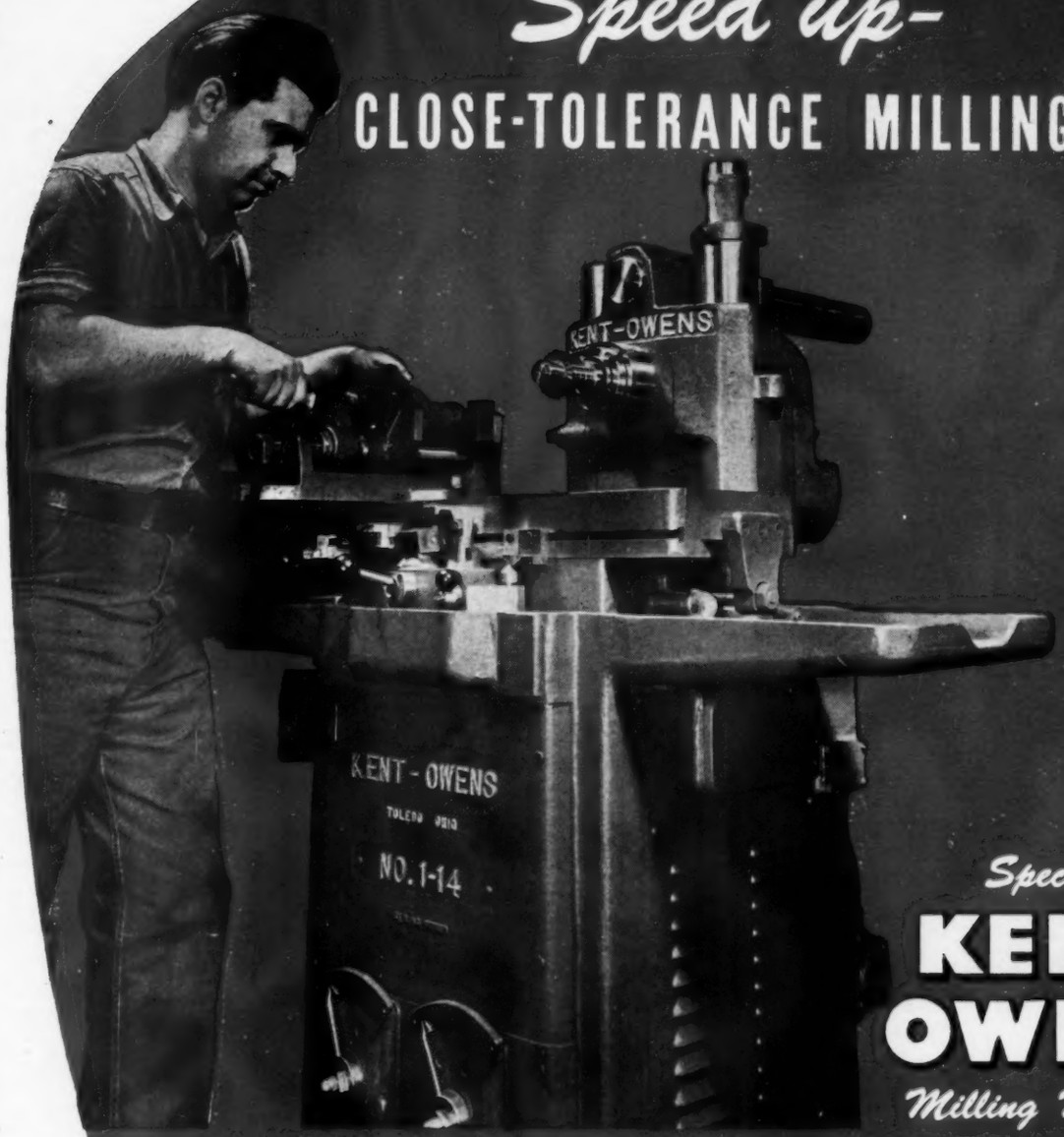
TELEPHONE: JAMAICA 6-4090

Speed up-

CLOSE-TOLERANCE MILLING!



No. 1-14 Milling Machine—Table, 32" x 9"—Table travel, 14"

Specify

KENT-OWENS

Milling Machines

Kent-Owens Machines welcome tough assignments in milling! They're adaptable to a wide range of work-problems . . . performing with utmost accuracy, speed and dependability. Operators find the going "smooth and easy" with Kent-Owens Millers. Ruggedly built . . . with practical features for simple and efficient operation. Write for latest bulletins. Kent-Owens Machine Company, Toledo, Ohio.

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CHICAGO — Neff, Kohlbusch & Bissell
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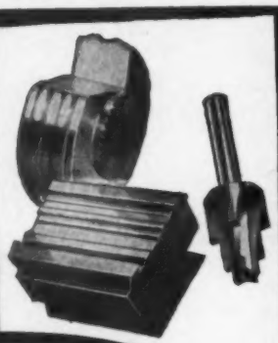
... PRECISION MADE FOR
EXACTING PERFORMANCE
AND
Mastercased
TO GIVE UP TO
500%
LONGER LIFE



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HIGH-SPEED
*Mastercased
CUTTING TOOLS

Meet the Challenge

*Mastercasing...
That's our improved super-heat-treating process which adds to the life of Masterform cutting tools...will multiply your production...will divide your costs per cut.

Want proof? Write, wire or phone for name of nearest-to-you factory representative..or without the slightest obligation, send specifications for estimates and complete information.

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OUTSTANDING ENGINEERING SERVICE AND CRAFTSMANSHIP

NATIONAL KEYSEATING MILLER

. . . the tool that converts drilling machines into key-seaters and saves time and money

• With this modern tool you can handle keyseating jobs not suitable for keyseating machines on any of your drill presses or radials. Keyseats with parallel sides, accurate in depth and in perfect alignment with bore axis are assured.

The National Keyseating Miller mills, keyseats in one cut. It can be used on taper holes, offset holes, blind holes and for taper keys. Work clamping is unnecessary. We also manufacture oil-grooving millers.

Made in twenty-six different diameters from ½" to 3½". Several widths of cutters can be used in each size.

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CINCINNATI, OHIO

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Nos. 0, 1, 2 Desmond-Huntington Dressers

We manufacture a complete line of Dressers and Cutters.
Write for copy of catalog "A".

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RANDALL and STICKNEY
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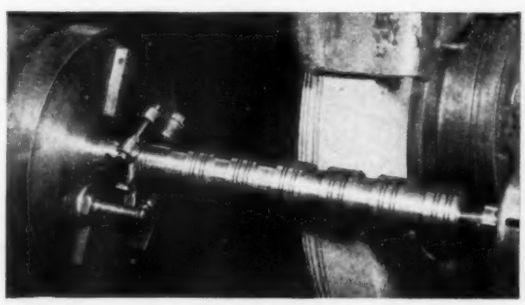

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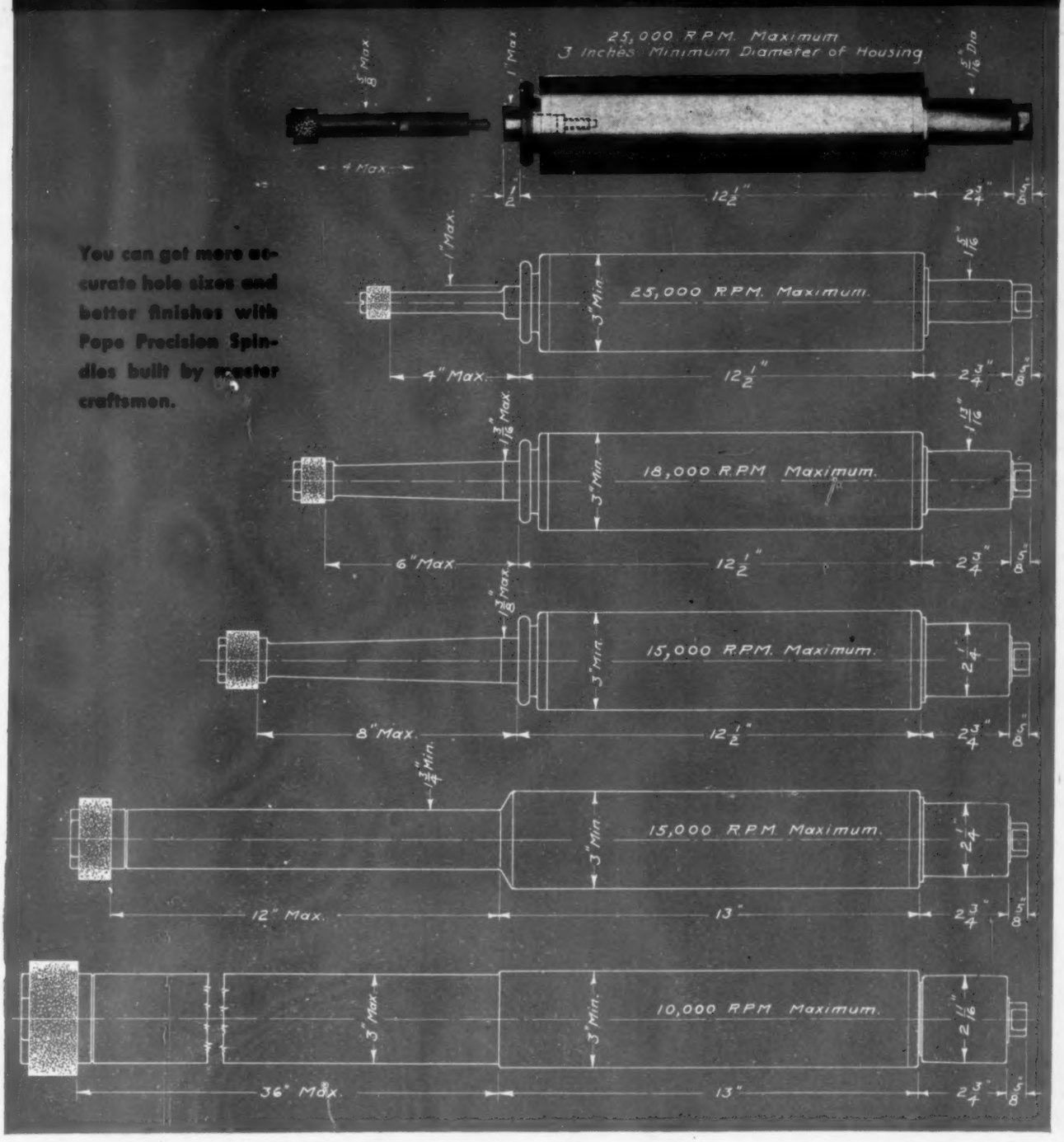

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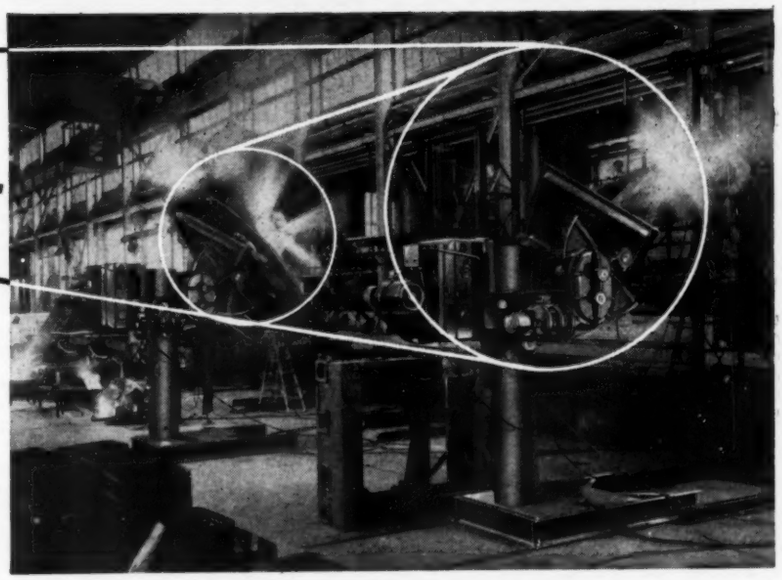

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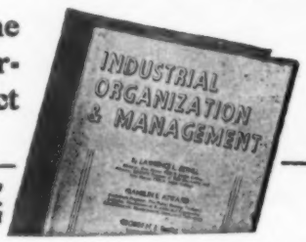

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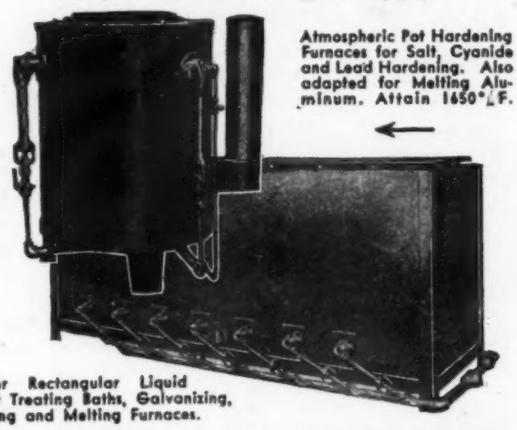

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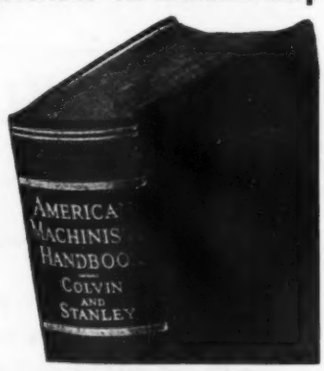

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PATENTS, COPYRIGHTS, Booklet "General Information concerning inventions and patents" and "Fee Schedule" sent without obligation. Established 1915, Lancaster, Allwine & Rommel, Suite 453, 815-15th St., N.W., Washington 5, D.C.

SEARCHLIGHT SECTION

(Classified Advertising)

EMPLOYMENT : "OPPORTUNITIES" : EQUIPMENT
BUSINESS : : USED OR RESALE

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Positions Wanted (full or part time individual salaried employment only) ½ the above rates payable in advance.
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A nationally known accounting firm has been requested by a client to secure suitable personnel for the following positions in their organization.

1. **Works Manager**
2. **Personnel Director**
3. **Industrial Engineer**

The company is long established and is well and favorably known in its industry. The plant is located in a fine residential section of New York State. All three men must be high caliber, over thirty years of age with at least ten years' experience in manufacturing, preferably metal working.

The Works Manager must be a graduate mechanical engineer thoroughly capable of handling production and methods problems. The Personnel Director must be a man of experience in coping with present day personnel problems. The Industrial Engineer must be a graduate engineer, have a thorough knowledge of Time Study and Methods, and be able to create a "Standards Department" and make it function.

These are newly created positions and future prospects are excellent. Salaries will be arranged commensurate with the individual and position. Applicants must furnish full personal history, which will be treated confidentially.

Address

P-582, AMERICAN MACHINIST
330 W. 42nd St., New York 18, N. Y.

WANTED

COST ESTIMATOR

Young man experienced in estimating manufacturing costs of heavy machinery. Engineering background preferred. Old established firm located in central Ohio. Excellent opportunities for advancement. Write today stating age, education, experience and expected salary. An interview will be arranged at your convenience. All replies confidential.

P-597, AMERICAN MACHINIST
330 W. 42nd St., New York 18, N. Y.

AN UNUSUAL OPPORTUNITY for a *DESIGN ENGINEER* experienced in Hydraulics as applied to Heavy Machine Tools; Familiar with Job Shop operations and desirous of enjoying small town living.

Barrett Machine Tool Company
Meadville, Pennsylvania

SALES ENGINEERS WANTED

Gage firm manufacturing patented gage and general line wishes to expand its coverage. Wants mfgs. representative in many territories. Write stating experience, connections, age, education, references, number of lines now handling, and territory desired.

P-599, AMERICAN MACHINIST
330 West 42nd Street New York 18, N. Y.

WANTED

MECHANICAL ENGINEER

Must be thoroughly experienced in all gear manufacturing problems as well as designing; only those with extensive gear experience need apply. Exceptional opportunity. Write full history including name of university and year graduated; names and addresses of all former employers; age; salary desired.

P-581, American Machinist
330 W. 42nd St., New York 18, N. Y.

WANTED

Experienced design engineer for immediate and permanent employment. By a progressive manufacturer of precision machine tools for rebuilding internal combustion motors, primarily automotive. A pioneer in the field with world wide distribution for over 25 years and located in medium sized mid-west city. If you would like to affiliate with a well-established company that is small enough so that individual merit is bound to receive just recognition, write giving complete personnel history, enclosing recent photograph. All replies confidential.

P-556, AMERICAN MACHINIST
330 WEST 42nd ST., NEW YORK 18, N. Y.

WANTED

Foreman for small Machine Shop located in Northwestern Pennsylvania. Must have had Machine Tool experience. Write giving age, experience, starting salary expected and when available.

P-527, AMERICAN MACHINIST
330 West 42nd St., New York 18, N. Y.

ASSISTANT SUPERINTENDENT

Medium sized metal manufacturing plant in Chicago. Must be thoroughly experienced in machine shop operation and supervision. Permanent position. Salary commensurate with background. Give full particulars in reply.

P-598, AMERICAN MACHINIST
330 WEST 42nd ST. NEW YORK 18, N. Y.

EXPERIENCED DESIGNER WANTED

For small tools such as die heads, etc. Good opportunity for high grade man. Give full particulars as to experience and salary desired. Application will be treated as strictly confidential.

CONSOLIDATED MACHINE TOOL CORP.
Rochester 10, N. Y.

SEARCHLIGHT SECTION

WANTED
MECHANICAL ENGINEER

Man required to take charge of engineering in a successful progressive organization in Toronto, Ontario. Should be from 32 to 42 years old and from 8 to 20 years successful experience. Knowledge of plastics essential and of textiles desirable. Must be familiar with mechanical design and factory maintenance. Must be a man of tact, ingenious, aggressive, a good coordinator and planner, capable of product design and process improvement. Replies must give complete education and experience, salary record and salary required. Adequate references necessary but these references will not be consulted until after an interview.

P-602, AMERICAN MACHINIST
330 W. 42nd St., New York 18, N. Y.

NEW PRODUCTS WANTED

Our client, an established manufacturer, wants new products or new ideas that might be developed into new products.

Experienced in steel casting, welding and machining in any combination—large sizes, great precision.

Selling industrial and manufacturing markets.

Please write Dept. 13. Communications in confidence. We are fully compensated by our client.

CHARLES H. WELLING & CO., INC.
52 Vanderbilt Avenue
New York 17, N. Y.
New Products—New Process

BARGAINS

36"x25' Bridgeford G.H. Engine Lathe, M.D.
22" Gisholt G.H. Automatic Turret Lathe, SPD
No. 42 Van Norman Oscill. Radius Grinder, M.D.
No. 45 Bilton Prod-Matic Mill, Motor in Base
No. 3-M Morey 2-Sp. Profiler, with motors
Becker Model C Vertical Mill, M.D.
Type 2M P. & J. Vertical Mill, SPD
50 Ton Hanna Air Riveter, 25" Throat
Pangborn Tumbling Sand Blast Machine
50 HP GE Turbines Cupola Type Blower

SURPLUS MATERIAL & MACHINERY CO.
8735 Kercheval Detroit 14, Michigan
Phone 3876 & 6843

WANTED—MACHINE DESIGNER

Experienced on special or paper working machinery. Excellent opportunity for permanent position. Location Philadelphia area. Please give complete details, age, experience, etc.

P-500, AMERICAN MACHINIST
330 West 42nd St. New York 18, N. Y.

WANTED TO BUY

2—10 foot Power Squaring Shear, 10 gauge or heavier
2—10 foot Chicago Brake, 7 gauge, or heavier

W-565, AMERICAN MACHINIST
330 West 42nd St., New York 18, N. Y.

#2-F, #3-F Fastermatic Turret Lathes. 450 ton and 350 ton Toledo Punch Presses
2½" to 4" bar Horiz. Boring Mills, 1 yr. old, $6,000.00 up.
5" Bar Newark Horiz. Boring Mill, 8' Bed, M.D., $2250.00
#17 Barber Colman Heavy Duty Gear Hobber, can take a hob up to 5¼" dia.
8', 16' Bullard Multaumatics, 1 yr. old
#4½ & #6 Bliss Punch Press, 100 ton cap. 1 yr. old
Quick Change Gear Lathes, $125.00 up complete
10x36, 16x88, 15x144" Ext. Grinders

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MDNA MEMBER
Detroit 8, Mich.
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Tyler 76300

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For midwest machinery builder. Must have thoro knowledge latest shop practice in competitive manufacturing. Must also be able to maintain presen good labor relations. Wide awake shop executive can earn substantial bonus in addition to his salary. Excellent opportunity in an active peaceime field.

P-601, AMERICAN MACHINIST
330 West 42nd Street New York 18, N. Y.

WANTED

CAM MILLING MACHINES
16"—20" or 24" Table

W-579, AMERICAN MACHINIST
330 WEST 42nd ST., NEW YORK 18, N. Y.

SHEET METAL MACHINERY

NEW and USED—Hand and Power Brakes, Shears, Forming Rolls, Folders, Punches, Rotary Machines, Stakes, Spot and Arc Welders

MDNA MEMBER
B. D. BROOKS, INC.
381 Atlantic Ave., Boston, Mass.

WANTED
SALES ENGINEERS

Young men with engineering background interested in selling heavy machinery to metal working and process industries. Old established firm located in central Ohio. Excellent opportunities for advancement. A good sales personality is essential. Write today stating age, education, experience and expected salary. Interviews will be arranged for those who qualify. All replies confidential.

SW-596, AMERICAN MACHINIST
330 W. 42nd St., New York 18, N. Y.

AUTOMATICS WANTED

We buy National Acme, New Britain Gridley automatic bar feed and chuck machines, all sizes from 1935 up. What have you to offer?

ROCO MACHINE COMPANY
91 SUNSET AVE. GLEN RIDGE, N. J.

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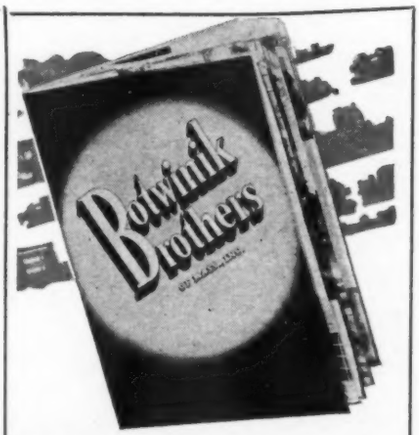
FOR SALE

Complete Micrometer Manufacturing Business, with capacity of 1500 tools per week. Established sales outlet. *Reasonably priced.*

REED SMALL TOOL WORKS
237 CHANDLER ST., WORCESTER 2, MASS.

Punch, Whiting No. 4
General Electric Arc Welder, 200 Amp.
Quick Work Seaming Machine 10A-1, M.D.
Drill, Bausch 12 spindle, No. 2 taper, M.D.
Grinder, 12" Arter Rotary, M.D.
Grinder, Bryant Internal No. 3, M.D.
Grinder, Cincinnati Universal 12x72
Lathe, LeBlond Multi-Cut No. 6, M.D.
Mill, LeBlond No. 4G Horizontal, M.D., extra vertical head
Mill, hand, Kent Owen No. 1, M.D.
Mill, Rockford Rigidmil, M.D.
Mill, Toledo Vertical No. 3V, M.D.
Shaper, Hamilton 24", M.D.
Turret Lathe, No. 3 Bardons & Oliver full universal, extra tooling, M.D.
Turret Lathe, No. 4 Bardons & Oliver, M.D. with drive-all
Turret Lathe, Warner & Swasey, No. 2 chucking machine, motor in base

MDNA MEMBER
Detroit Machinery Exchange
955 E. Vernor Highway Detroit, Mich.



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Just published! A complete story of Botwinik's exceptional facilities and immense stock of quality used machine tools. Your free copy is waiting for you. Send for it.

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WHEN answering the classified advertisements in this magazine, don't forget to put the box number on your envelope. Its our only means of identifying the advertisement you are answering.

Delta 2 spindle 17" drill press.	$370.00
(This machine bought June 1945 for $470.00 and not used).	
22" Upright Drill #3 Morse Taper	$175.00
Lodge & Shipley 18"x12' lathe.	$1000.00
Lodge & Shipley 16"x5' lathe.	$400.00
Reliable 10"x57" lathe.	$250.00
Yale 2 ton Spur geared chain hoists.	$75.00

UTILITY ELEVATOR SERVICE, INC.
34 Jumel Place New York 32, N. Y.

1—Cleveland 8 Spindle Rigidturner.
4—Ex-Cello Vertical Turning Lathes.
4—Hole Engineering Co. 2 sp. Milling Machines.
1—Cincinnati #18 Vertical Milling Machine.
1—Pratt & Whitney #1 Hor. Drilling Machine.

CONTINENTAL SALVAGE & MACHY. CORP.
334 Union Bldg. 1836 Euclid Ave. Cleveland 15, O.

EVERY ITEM GUARANTEED AS REPRESENTED

FALK FOR DEPENDABILITY IN REBUILT MACHINERY

AUTOMATICS

6—#61 New Britain-Gridley 6 Spindle 1⅝" cap. Automatic Screw Machines. A.C. Motor Drive, Threading Spindle.
1—1¼" Cone 4-spindle Automatic, Motor Driven, Threading Spindle.
1—#515 National Acme 1⅝" 4-spindle Automatics, complete
2—#55 National Acme 1⅝" 4-spindle Automatics, complete
1—#2G Brown & Sharpe Automatic.
1—#1 Brown & Sharpe Automatic, old style.

BORING MILLS

100" Niles-Bement-Pond Bor. & Turn. Mill.
3½" Bar Landis-Rochester Horizontal Boring Mill, Model #36.
#31 Lucas Horizontal Boring Mill, 3" bar.
72" Cincinnati Heavy Pattern Vertical Boring and Turning Mill.

DRILLING MACHINES

Avey, 2 & 3 spindle Prentice, 4 spindle.
Henry & Wright, 6 spindle, #2 M. T.
Fosdick 13" Super speed 4-spindle drills.
Natco #12, 12 spindle #1 M. T.
Natco #14, 22 spindle Rectangular head Drilling Machine.

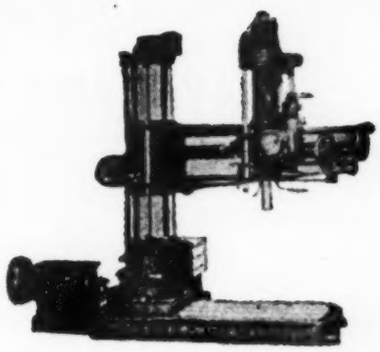
RADIAL DRILLS

3' 9" column Cincinnati-Bickford.
3' 9" col. American, S.P.D.
3' Dreses, 10" col. QCG., M.D.
3' 10" Col. Fosdick
5' Arm 13" Column Cincinnati-Bickford.

GRINDERS

12" No. 22 Heald Rotary Surface Grinder.
16" Persons-Arter Rotary Surface Grinder.
#4 Brown & Sharpe Universal Grinder.
#12 Greenfield Internal Hydromatic Grinder, sizematic type, complete with Tank and Pump. 15" swing, 5" hole, 4" dee.
Oliver Model 51 Drill Grinder; 1½" cap.

Blanchard Grinder #16, 30" dia. magnetic Chuck, 25 HP 3-60-440 V. Motor.
2—#2 Cincinnati Centerless Grinder.
Pratt & Whitney Vertical Surface Grinder, 14"x36" with 10"x36" Magnetic Chuck. Ball Bearing Spindle. Perfect Condition.
#2 Cincinnati Universal Tool and Cutter



Cincinnati-Bickford 5' Arm, 13" round column with air clamp. Oil grooved, tee slotted base, side base, with plain box table with #5 Morse Taper spindle. Motor drive.

#2 Brown & Sharpe Surface Grinder.
#70 Heald Internal Grinder.
#60 Heald Cylinder Grinder.
#11 Brown & Sharpe Plain Cylindrical.
10" x 18" Norton Cylindrical.

LATHES

14" x 6' Hendey Toolroom Lathe, geared head.
14" x 8' Hendey Toolroom Lathe, motor drive.
14" x 8' LeBlond Toolroom Lathe, cone drive.
14" x 12' Hendey Toolmakers Lathe, motor drive.
16" x 6' Rockford Toolroom Lathe.
16" x 6' American Motor Driven Lathe.
16" x 8' American Motor Driven Lathe, taper.
27" x 18' Lodge & Shipley Geared Head Lathe.
26" x 12' Putnam Quick Change Gear Lathe.

TURRET LATHES

16" Warner & Swasey Brass Lathe.
#2A Warner & Swasey Universal Turret Lathe.
#4 Warner & Swasey Universal Turret Lathe.
#4 Foster Turret Lathe.
#6A Potter & Johnson Automatic Chuckers.

MILLING MACHINES

#3, #4, #5 Cinn. High Power, Plain, S.P.D.
No. 0 Bickett Vertical Bench Miller.
#1-#1½-#2 Brown & Sharpe Plain Miller.
P & W 2½" Duplex Spline Miller.
Hall Planetary Thread Miller 24".
#8 Lees Bradner Thread Miller.
#1, #2 Kempsmith Plain Millers.
#2½, #3 LeBlond Universal.
3B Hendey Universal Miller, single pulley drive.

PLANERS

30"x30"x10' Cinn. Heavy Pattern, 2 Hds.
20"x20"x24" N.-B.-P., Planer Shaper, M.D.
24"x24"x6' Cincinnati, 2 heads, M.D.

POWER PRESS HEADQUARTERS

#4 Bliss D. C. Forging Press.
200 ton A.C.F. Hydraulic Press. Bed 24" x 36", 4-post.
3—25 ton K. R. Wilson Hydraulic Presses.
Beck Duplex Embossing Press.
75 ton H.P.M. 2 post, Hydraulic Press.
#1 Bliss Straight Side, double action, Cam Press. Will draw and lift out 2¾".

SHAPERS AND GEAR CUTTERS

12" Schuchart & Schutte Gear Hobber.
#1 Adams Gear Hobbers, Belt driven (3).
16" Gould and Eberhardt
21" Smith & Mills B.G. Helical Gears.
24" Gould & Eberhardt Shaper.

SHEARS & METAL CUTTING MACHINERY

Lennox Splitting Shear, ¾" cap.; 8' throat.
Lennox Bevel Shear, ¾" cap.
Gould & Eberhardt Slitting Shear, 10 ga.
Bertsch 3"x36" Geared Slip Roll Former.
Niagara 48" Roller Leveller, 6 Rolls.
12' x 14 Ga Loy and Nawrath Squaring Shear.

MISCELLANEOUS

Waterbury-Farrel Cold Header, double stroke, open dia, ½" cap. & 6".
Manville Cold Header, single stroke, solid die, 3/16" cap.

Thomson Cutter and Creaser, 12½x18½.
Heat Treating Furnaces for the tool room.
Hydraulic Pumps—Hele Shaw, Racine, Oil Gear, Motor Driven.
Blake and Knowles 12x2x12 Simplex Type, Hydraulic Steam Pump, 2000 lbs. pressure with 80 to 125 lbs. steam, delivers 9 gallons per minute.
No. 7B High Speed Riveting Hammer, cap. ¾" to 1½. New this year.
#5A High Speed Riveting Hammer.

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MACHINERY COMPANY
Machinery Merchants

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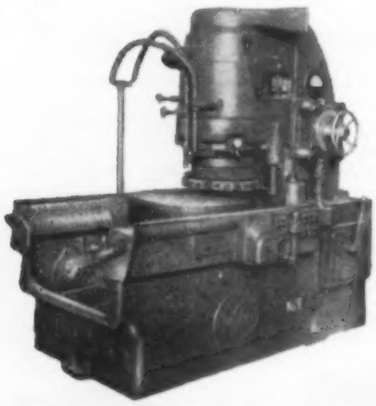
. . . precision rebuilding

AVAILABLE for PROMPT SHIPMENT

GRINDERS

HEALD #70 Internal
BROWN & SHARPE #5 Pl. Cyl. 3x18; latest type
LANDIS 4x12 Type H Pl. Cyl. Hydraulic; latest type
LANDIS 10x48 Type C Pl. Cyl. Hydraulic; latest type
NORTON 24x240 Pl. Cyl.; motor drive
BROWN & SHARPE #2B Surface; latest type
NORTON 6x18 Surface; latest type
THOMPSON 6x18 Type F Surface; latest type



BLANCHARD #18, 30" chuck; latest type

BLANCHARD #16 motor drive; 26" chuck
PRATT & WHITNEY 14x60 Sur. Hydraulic; latest type
ARTER 8" Rotary Surface
ARTER Automatic Piston Ring
BROWN & SHARPE #1, #2, #3 Univ.; latest type
LEBLOND #2 Univ. Tool & Cutter; latest type
BROWN & SHARPE #13 Univ. & Tool; latest type
PRATT & WHITNEY Contour Cutter Grinder; latest type
UNIVERSAL Spline Shaft; Hydraulic

BORING MILLS—Horizontal

LUCAS #32, 3¾" Bar; Latest Type
LUCAS #41, 3" bar; latest type
LUCAS #42, 4" bar; latest type
GIDDINGS & LEWIS #0, 3⅛" bar
NILES BEMENT POND, 5' Bar
NILES BEMENT POND, 7" Bar

BORING MILLS—Vertical

BULLARD 24", 36", 42" New Era Type
BULLARD 54" Spiral Drive; latest type
KING 72", 2 swivel heads; motor drive
NILES BEMENT POND 84", 2 Swivel heads; Motor Drive
NILES BEMENT POND 120", 2 Swivel heads; Motor Drive

DRILLS

AVEY #1, 3 spindles
AVEY #2, 1 to 6 spindles
LELAND & GIFFORD #1, 1 & 2 spindles
COLBURN #D3; capacity 3"
NATCO #12 multiple spindle
NATCO C-13H multiple spindle
PRATT & WHITNEY #1/2B x 30"; #1/2B x 50", 2 spindle Deep Hole
CINCINNATI BICKFORD 3'9" Radial; latest type
AMERICAN 5'11" Radial; latest type

GEAR CUTTING EQUIPMENT

FELLOWS #712 Gear Shaper
GLEASON 3", 6", 11", 18" Bevel Gear Generators
GLEASON 12" Bevel Gear Generator; late type
GLEASON 10", 15" Spiral Bevel Finisher
GLEASON Bevel Gear Tester
BROWN & SHARPE #13 Gear Cutter
BROWN & SHARPE #6 x 60 Gear Cutter
GOULD & EBERHARDT 3 spindle Gear Cutter
BARBER COLMAN #3 Gear Hobber
GOULD & EBERHARDT #96H Gear Hobber
CINCINNATI Gear Burnisher

PLANERS

CINCINNATI 24" Crank
LYND FARQUHAR 26" Open side
GRAY 30x30x8', 2 heads
CINCINNATI 30x30x10' Box Table, PRT, 2 hds.
CINCINNATI 36x30x5' Box Table, Prt, 1 hd.
CINCINNATI 36x36x12' Box Table, PRT, 4 hds.
HAMILTON 42x42x20', 4 heads
GRAY 48x48x16', 4 heads
CLEVELAND 48x48x16' Open Side, 3 hds.
DIETRICH & HARVEY 48x48x16', 4 hds, Hydraulic
WOODWARD & POWELL 60x60x20', 4 heads
GRAY 72x48x12', 2 heads
NILES BEMENT POND 96x80x20', Box Table, 4 hds, Hydraulic, PRT
CINCINNATI 120x96x20', 4 hds, box table, PRT

MOREY MACHINERY

USED MACHINE TOOLS

MILLING MACHINES

BROWN & SHARPE #2A Univ., Timken Bearing, latest type
VAN NORMAN #26, #36 Univ., Timken Bearing, latest type
BROWN & SHARPE #2B Pl., standard type, Timken Bearing
KEARNEY & TRECKER #2H, #2K Plain, Timken Bearing
CINCINNATI #3DT Ver., Timken Bearing
GORTON #8D Ver., high speed, latest type
KEARNEY & TRECKER #3K, #4K Ver., Timken Bearing
BROWN & SHARPE #10, #12 Auto., Timken Bearing
KEARNEY & TRECKER #1218 Auto., Timken Bearing
CINCINNATI 45x48 Hydramatic, Timken Bearing
INGERSOLL 42x36x16' Planer type, 4 heads
MOREY #12M 2-spindle Milling & Profiler

JIG BORERS

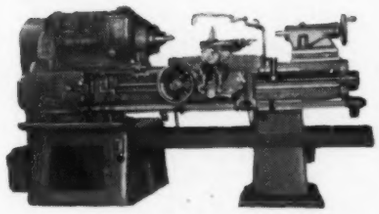
CINCINNATI BICKFORD 28", latest type
LINLEY High speed, latest type

THREAD MILLING MACHINES

PRATT & WHITNEY 4½x12, 6x20 Model C, latest type
LEES BRADNER Model LT 6x36, latest type
PRATT & WHITNEY 6x120, 6x132, motor drive
MOREY SHIELDS 12x30, 12x60, 12x120, 12x192, latest type

SHAPERS

PRATT & WHITNEY 6" Vertical
MOREY 10" Vertical, latest type
PRATT & WHITNEY 10" Vertical
MOREY 14" Vertical, latest type
MORTON 30" Draw Cut
DILL 18" Vertical Slotter



LODGE & SHIPLEY 14x30 centers, Timken Bearing, latest type

LATHES

MONARCH 10x20 centers Model EE, Timken bearing, latest type
MONARCH 14x30 centers Timken Bearing, latest type
MONARCH 14x54 centers Timken bearing, latest type
HENDEY 14x6' bed, geared head, motor drive
HENDEY 16x6' bed, geared head, motor drive
AMERICAN 16x8' bed
LODGE & SHIPLEY 18x8' bed, geared head
LEBLOND 18x54 centers, Timken bearing, latest type
LEBLOND 21x16' bed, geared head
MONARCH 30"x10' bed, Timken Bearing
HARDINGE Type TR 59 High Speed
HENDEY 12x54 centers Mfg. Type
HENDEY 14x42 centers Mfg. Type; latest type
HENDEY #3x54 centers Mfg. Type
LEBLOND 17x6', 9' and 14' bed Timken Bearing, Mfg. Type

LATHES—TURRET

MOREY #2G, 1" cap. Timken Bearing
MOREY #3 Univ., 1½" cap. Timken Bearing
MOREY #4 Univ., 2" cap. Timken Bearing
WARNER & SWASEY #1A Univ. Timken Bearing
WARNER & SWASEY #2A Univ. Timken Bearing
WARNER & SWASEY #3 Univ. 1½" cap. Timken Bearing
GISHOLT #2L Univ. Timken Bearing
POTTER & JOHNSON #6C; motor drive

AUTOMATIC SCREW MACHINES

CLEVELAND ⅞" to 2½" Model A

PRESSES

CLEARING #SO-842 single action, 215 tons, latest type
CLEARING #SO-832 single action, 215 tons, latest type
CLEARING Type K-1200-30 Knuckle Joint, 200 tons, latest type
CLEARING Type F-1100-36 single action, 100 tons, latest type
CLEARING Type 730 single action, 160 tons, latest type

MISCELLANEOUS

CLEVELAND 12x16" Cutter Relieving Machine
COLONIAL Model FS-2-72 Broach
WATSON STILLMAN Hyd. Straightening Press
BILLINS & SPENCER #2 Hot Trimmer
BLOUNT 4"x6' Speed Lathe
SAUNDERS #9, 8 to 18" Pipe Machine

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TELEPHONE—CANAL 6-5360

EASTERN OFFERS FROM STOCK

AUTOMATICS

4 spindle 7/8" Cleveland Model M, m.d.
4 spindle 2" Cleveland Model M, m.d.
4 spindle 2¼" Cleveland Model K, m.d.
2¼" Cleveland Model A, m.d.
2¼" Gridley Single Spindle, m.d.
2½" Cleveland Model A, m.d.
4¼" Cleveland Model A, m.d.
5¼" Cleveland Model A, m.d.
6" Cleveland Model A, m.d.
7⅜" Cleveland Model A, m.d.
14" Fay, m.d. Flanders Type
No. 6A Potter & Johnston, m.d.
No. 6C Potter & Johnston, m.d.
No. 6D Potter & Johnston, m.d.
No. 22 New Britain
No. 23 New Britain
No. 33 New Britain

BOLT THREADING MACHINES

¾" Economy Style R, with Lanco Head
3 spindle 1¼" Acme

VERTICAL BORING MILLS

24" Bullard New Era, m.d., with side head
36" Bullard New Era, m.d., with side head
42" Bullard New Era, m.d., with side head
42" Colburn, m.d., 2 heads on rail
48" Cincinnati Rapid Production, 1 turret, 1 swivel head, m.d.
52" King, m.d., 2 swivel heads
54" Bullard Spiral Drive, m.d., with side head, latest
53" Niles, m.d., 2 swivel heads
72" Colburn, m.d., 2 swivel heads
84" Niles, m.d., 2 swivel heads
54" Colburn, m.d. 2 swivel heads

HORIZONTAL BORING MILLS

No. 32 Giddings & Lewis, m.d.
Morton 60" stroke Horizontal Boring, Drill and Milling Machine and Draw Cut Traveling Head Planer, m.d.
No. 0 Giddings & Lewis, m.d., 3¼" bar
No. 21 Lucas, 2½" bar, m.d.
No. 31 Lucas, 3" bar, m.d.
4" bar Detrick & Harvey Floor Type, m.d.
4" bar Niles, m.d.
4½" bar Niles, m.d.
5" bar Niles Floor Type, m.d.
5½" bar Niles-Bement-Pond Table Type, m.d.
6" bar Niles-Bement-Pond Floor Type, m.d.
10" bar Sellers Floor Type, m.d.

GEAR CUTTING MACHINERY

Type A Barber-Colman Gear Hobber, m.d., latest
3" Gleason Straight Bevel, m.d.
6" Gleason Straight Bevel, belt
8" Gleason Mfg. Straight Bevel, m.d.
9" Pratt & Whitney Hydraulic Spur Gear Grinder, m.d.
10" Pratt & Whitney Hydraulic, m.d.
11" Gleason Straight Tooth Bevel Gear Generator, belt
11" Gleason, m.d.
12" Gleason, m.d.
48" Cleveland Hobber, m.d.
Gleason Spiral Bevel Gear Rougher, s.p.d.
No. 2HS Lees-Bradner Spur & Helical Gear Grinder m.d., latest
No. 3 Heavy Brown & Sharpe Auto. Spur Cutter, m.d.
No. 3-26" Cincinnati Auto. Spur Gear Cutter
No. 3-36" Brown & Sharpe
No. 4-36" Brown & Sharpe
No. 6-60" Brown & Sharpe
No. 12 Barber-Colman Double Overarm Gear Hobber, m.d.
No. 13 L8 Fellows Gear Lapper, m.d.
No. 36B Gould & Eberhardt Spur & Bevel Gear Cutter, m.d.
No. 36S Gould & Eberhardt Spur Gear Cutter, m.d.
No. 61 Fellows Gear Shaper, belt
No. 64-S Fellows Gear Shaper, m.d.
No. 71A Fellows N.S. Gear Shaper, m.d.
Cincinnati Gear Burnisher, m.d.
Cross Gear Rounder, m.d.
Schuchardt & Schutte Gear Tooth Rounder, belt

CENTERLESS GRINDER

No. 2 Cincinnati, m.d., 1942 machine
No. 2 Cincinnati, m.d. (8)
Cincinnati Valve Seat Grinder m.d.

UNIVERSAL CYLINDRICAL GRINDERS

No. 2—12x30" Brown & Sharpe, belt
12x36" Cincinnati, belt
16x68" Landis, belt

More than 1200 machines in stock for prompt shipment. Send us your inquiries.

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96" Cincinnati Massive Pattern
61" Bullard Maximill
54" & 42" Bullard V.T.L.
3½" bar Lucas horizontal
3" & 2½" Universal horizontal

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4' Carlton radial
4' Hammond radial
34 spdl. No. 30 Natco multiple
20 spdl. No. 4 Baush multiple, 2" spdl. No. 3 taper, hydraulic feed
24", No. 25 Foote Burt heavy
21" & 24" Cincinnati upright

GEAR CUTTERS

Nos. 3 & 12 Barber Colman hobbers
Nos. 16HS & 18H Gould & Eberhardt
Nos. 7 & 61 Fellows shapers
Nos. 1 & 5A Lees Bradner hobbers
11" Gleason bevel generator
18" Gleason testers & lappers
No. 3 Barber Colman hob grinder

GRINDERS

36", No. 18 Blanchard surface
16", No. 10 Blanchard surface
18" Arter rotary surface
14" Pratt & Whitney vert. surface
6"x18" Norton hydr. surface
6"x18", No. 2 B. & S. surface
No. 2 Brown & Sharpe universal
No. 1½ Cincinnati tool & Cutter
No. 104 Rivett internal
No. 72A3 Heald Sizematic internal
53" & 72" Gardner horizontal disc
20", No. 120A Gardner opposed disc
No. 2 Cincinnati centerless

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No. 2B Nazel pneumatic
2000 lb. Chambersburg board drop
2000 lb. & 3000 lb. Billings & Spencer board drop

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60"x37'9" Niles-Bement-Pond geared head
60"x75'6" N-B-P double end
36"x16'6" Bridgeford geared head
14"x6', 16"x8' & 16"x10' Hendey
17"x6' Leblond grd. hd. Mfg.
14"x18" Monarch Magnamatic
14"x19" Fay automatic
15"x22½" Sundstrand auto. stub.
8" & 12" Sundstrand stub.

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Nos. 2B & 3B Milwaukee Plain
No. 5 Cincinnati High Duty Plain
No. 35 Ohio universal
No. 2 Cincinnati dial type vertical
No. 2 Brown & Sharpe vertical
No. 2½B Milwaukee vertical
No. 4—36 Cincinnati Hydromatic
No. 3 Sundstrand Rigidmil
30" x 48" Newton rotary

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6" Pratt & Whitney vertical shaper
16" Ohio shaper
24" G. & E. shapers
36" Morton draw cut shaper
24"x24"x6' Gray planer
30"x30"x12' Cleveland openside

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2½", 4" Binsee

VERTICAL

66", 120" Niles
54" Colburn, M.D., 2 hds.

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Foster Nos. 4, 5, 6, 1B, 3B M.D. Univ.
J. & L. 2¼"x24", 3¼x30".
Acme 3¼" M.D.
No. 1L Gisholt Univ. M.D.

GRINDERS

P. & W. 14", 18", B.B., Vert. M.D.
Blanchard 30", M.D.; Modern 12x48", M.D.
Norton Hydraulic 12x18", M.D.
Heald Nos. 72A3 Gagematic
Norton 50"x28', M.D.
Landis Type A 6x20" Hydraulic, M.D.
Bryant No. 12, M.D.
Nos. 50, 55, 60 Heald Int. Hydraulic, M.D.
12" Heald Rotary, Arter 12" M.D.
B. & S. No. 2 Surface, M.D.
Norton 10x36" Hydraulic, M.D.
B. & S. No. 10 1' Cyl.
No. 2 Cincinnati Centerless, M.D.
B. & S. No. 1, 3 Universal
#25, #35 G. & L. M.D.

LATHES

McCabe 26-42"x14'
26x12' Boye & Emmes 3 step cone, B.D.G.
20"x14' Rahn-Larmon, raised to 24"
14"x6', 16"x6' Hendey
9" LeBlond Automatic
36x30' Putnam, M.D.
36x22" Putnam S.C.G., D.C.M.D.
32"x36' Wickes
Putnam 42x16', M.D.
30x26' L. & S. 12 speed M.D.
P. & W. 1x18, 1¼x18 Automatic Lathes

AUTOMATICS

B. & S. No. 2, Hand Screw
B. & S. No. 00, 0, 00G
5 Spdle. Davenport 9/16" cap.
Cleveland Model A ½", ⅝", 1¼", 2"
Cleveland Model B 1", 2"
P & J. 6A, M.D.
⅞" Cone 4 spindle

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5, 10, 18 ton OBI Power Presses
7" Ammco Shapers
Halco H.S. Vertical Milling Heads, Drill Presses

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4', 5', 6' American Triple Purpose
4', 5' Cincinnati-Bickford
4' Mueller, M.D.; 4', 5' Western, S.P.D.

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Gorton 8D Vertical, M.D., 9J
Cincinnati, #2 Univ.
No. 3S Cincinnati, S.P.D. rapid trav. M.D.
Nos. 1Y, 0Y, 3, 4, 5 B & S Plain & Univ.
B. & S. Nos. 12, 13, 13B
Hall Planetary Model D Thread Miller
Providence Planer Type 32"x8'
Becker Nos. 3, AB, 5, 6 Vert.
Nos. 3, 4, Cincinnati Vert.
P. & W. No. 12, 30 Profiler, M.D.
No. 4 B. & S. Universal
K. & T., B. & S. No. 2, 3 like new
B. & S. No. 2, 3, Vert.
Kempsmith No. 1 Univ.

MISCELLANEOUS

Gorton No. 1S, 3U Engraving Machine
6 spindle Avey Drill, 15" overhang
Rochester No. 5½" B Hammer
6" Vertical Shaper
P. & W. Pipe Machines, 4", 6", 8", M.D.
N.B.P. 15" Slotter, M.D.
#7 Burr Keyseater
Natco No. 13 Multiple Spindle Drill
No. 8 Marvel Band Saw, M.D.

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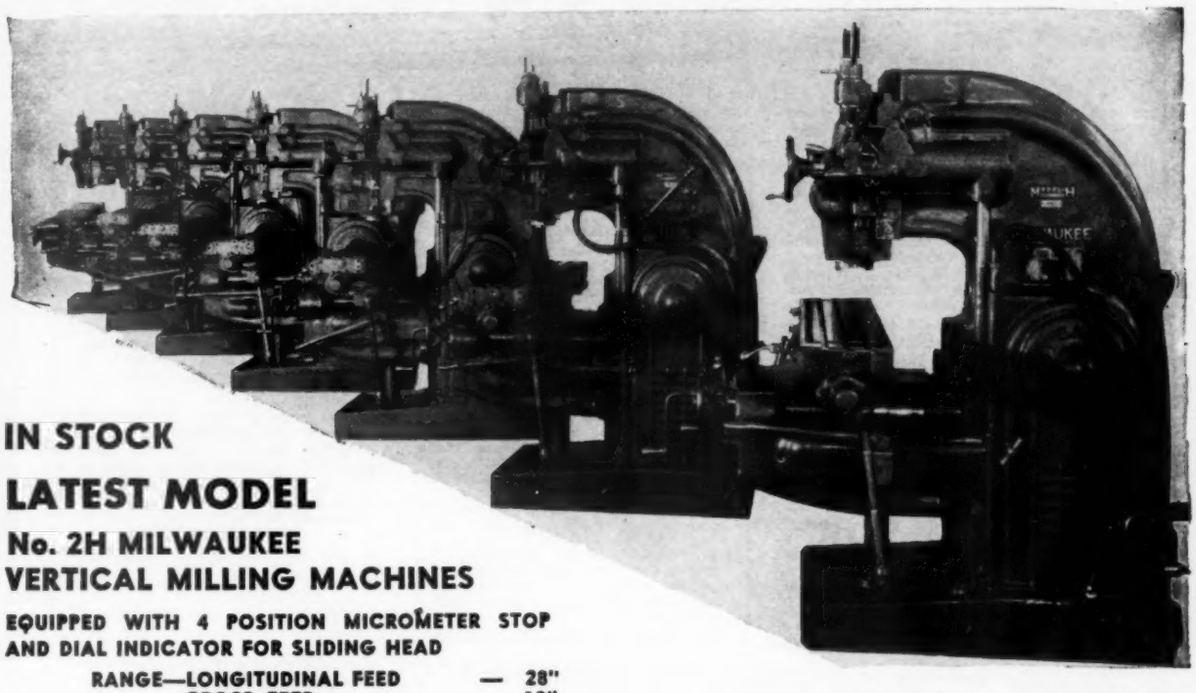

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RANGE—LONGITUDINAL FEED	—	28"
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#2KM Kearney & Trecker Plain Miller

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10" x 20" Monarch "EE" Toolmakers' Lathe

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PLANER, METAL—WOODWARD & POWELL 36"x36"x8'; 1 rail head, 1 side head.
TURRET LATHES—FOSTER No. 1-B Univ. ine. 2 Wrenches Chucks, etc. M.D.; also W & S No. 3-A, Univ.
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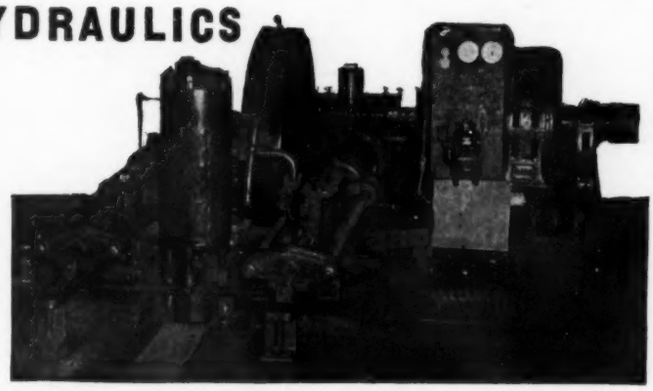

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2300 Volt Synchronous Motor 3 Phase 60 Cycle
ALSO—75 H.P. Hor. 4 Pl. Pump—50 G.P.M.—2000#
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24" BULLARD New Era Vertical, one swiveling turret head, one side head.

42" BULLARD New Era vertical, one swiveling turret head, one side head.

3" Bar Universal TRI-WAY Horizontal Boring Mill with 32" x 58" table. P.R.T.

No. 1 PUTNAM Vertical Car Wheel Boring Mill, side head for hub facing and hoist. AC or DC motor drive.

72" COLBURN vertical, 2 swivel heads, all geared speeds, Power Rapid Traverse.

84" CINCINNATI Rapid Production, 1 swivel head, one turret head, Power Rapid Traverse.

100" NILES-BEMENT-POND Vertical, 2 swiveling heads, Power Rapid Traverse.

MILLERS

42" x 26" x 12' INGERSOLL Planer Miller, 4 heads, M.D.

No. 4 CINCINNATI High Power Plain, Power rapid traverse table 16½" x 64". Single pulley belt drive or AC or DC.

No. 4 CINCINNATI High Power Vertical Power rapid traverse. Table 16½" x 64". Single pulley belt drive or AC or DC motor drive.

No. 5 CINCINNATI Plain Rectangular overarm.

LATHES

30" x 18' LODGE & SHIPLEY Selective geared head, taper attachment.

36" x 30' LODGE AND SHIPLEY 18 speed selective geared head screw cutting engine lathe, 2 carriages. AC or DC motor drive.

42" x 36" PUTNAM Geared Head, 25' between centers. Quick change gear box.

48" x 20' NILES-BEMENT-POND Extra Heavy Geared Head, 11'5" between centers. Power cross and angular feed to compound rest. Semi-quick change gear, taper attachment.

60" x 48' N-B-P Geared Head Engine Lathe.

RADIAL DRILLS

4' AMERICAN Plain triple purpose enclosed head drill, tapping attachment.

5½' AMERICAN Full Universal Triple Geared Tapping Attachment.

6' AMERICAN Triple purpose, plain radial, motor on arm.

GEAR HOBBER

100" GOULD AND EBERHARDT Horizontal for spur, helical and worm gears. Max. capacity 101" diameter. 48" face. Forced feed lubrication.

PLANERS

36" x 36" x 12' CINCINNATI Standard Planer, 2 heads on rail, power elevation to rail, AC or DC motor drive.

120" x 96" x 20' CINCINNATI, Rapid Traverse Planer with 4 heads and 230 V. DC reversing planer motor and control.

72" x 72" x 15' N-B-P Heavy 4 heads, double deck table. 230V, DC Reversing motor drive.

16' x 10' x 30' BETTS Heavy, 2 heads on rail and 2 side heads, forced feed lubrication. 230 V DC reversing type planer, motor and control.

SLOTTERS

6" & 10" PRATT & WHITNEY Vertical Shaper with 20" rotary table, power feeds, tilting ram. AC or DC motor drive.

15" NEWTON Crank Slotter, 30" circular table, AC or DC.

MISCELLANEOUS

30' No. 3 HILLES & JONES Plate Edge Planer.

30' x ⅞" NBP Bending Rolls, pyramid type.

No. 2 PRATT & WHITNEY Jig Borer with 22" x 44" table.

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200 Ton Alliance 100' Span
175 Ton Morgan 54" Span
150 Ton Whiting 30' Span
80 Ton "American" 40'6" Span
75 Ton Alliance 37' Span
75 Ton Alliance 78' Span
50 Ton Cleveland 71'10½" Span
50 Ton Shaw 69'10" Span
40 Ton Alliance 82' Span
35 Ton Northern 22' Span
30 Ton Case 41' Span
30 Ton Morgan 30' Span
30 Ton Morgan 77' Span
30 Ton Niles 53'9" Span
30 Ton P & H 80' Span
30 Ton Reading 58' Span
25 Ton Bedford 50' Span
25 Ton Cleveland 106' Span
25 Ton P & H 70' Span
25 Ton Whiting 106' Span
25 Ton Whiting 82' Span
25 Ton Whiting 58' Span
20 Ton Alliance 77' Span
20 Ton Cleveland 65' Span
20 Ton Morgan 77' Span
20 Ton Northern 60' Span
20 Ton P & H 39'6" Span
20 Ton P & H 54'4" Span
20 Ton Shaw 76'4" Span
20 Ton Shepard Niles 49'8" Span
20 Ton Shaw 76'4" Span
15 Ton Alliance 50' Span
15 Ton Alliance 35' Span
15 Ton Cleveland 55'6" Span
15 Ton Cleveland 35' Span
15 Ton Morgan 77' Span
15 Ton Niles 32' Span
15 Ton Northern 53' Span
15 Ton Shaw 82' Span
15 Ton Shaw 77' Span
15 Ton Toledo 82' Span
15 Ton Whiting 74'8½" Span
15 Ton Whiting 71'10½" Span
12 Morgan 56' Span
10 Ton Alliance 53'8" Span
10 Ton Alliance 71'10" Span
10 Ton "American" 27' Span
10 Ton Cleveland 38' Span
10 Ton Cleveland 50' Span
10 Ton Emsco 30' Span
10 Ton Lane 50' Span
10 Ton Morgan 39'5" Span
10 Ton Morgan 77' Span
10 Ton P & H 57' Span
10 Ton P & H 78' Span
10 Ton P & H 87'6" Span
10 Ton Northern 34' Span
10 Ton P & H 49'10½" Span
10 Ton P & H 60' Span
10 Ton P & H 80' Span
10 Ton Shaw 68' Span
10 Ton Shaw 58' Span
10 Ton Shaw 88' Span
10 Ton Northern 71'10½" Span
7½ Ton Erie 70' Span
7½ Ton P & H 30'6" Span
7½ Ton Scullin 71'10½" Span
7½ Shepard 36' Span
6 Ton Shaw 23' Span
5 Ton "American" 10' Span
5 Ton Champion 37'6" Span
5 Ton Euclid
5 Ton Milwaukee 39'8" Span
5 Ton Milwaukee 66'9" Span
5 Ton Milwaukee 70' Span
5 Ton Northern 49'6" Span
5 Ton P & H 45' Span
5 Ton Shaw-Box 25' Span
5 Ton Shepard 40' Span
5 Ton Toledo 98' Span
5 Ton Whiting 80' Span
3 Ton P & H 46'4" Span
3 Ton Shaw 33" Span
3 Ton Whiting 57'3" Span
2 Ton Detroit 28' Span
2 Ton P & H 46'4" Span
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1½ Ton Cleveland 25' Span
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★ **No. 61 New Britain, Six Spindle Automatic 1⅝" Bar capacity with chip conveyor and complete tooling; motor driven with motor and controls. New in 1943.**

★ **16" x 33" Fay Automatic Lathe, arranged for chucking, with Logan pump and accumulator, motor driven with motor and controls. New in 1941.**

AUTOMATICS

1" x 5" New Britain Automatic, six spindle.
⅞" Cleveland Model M, four spindle.

DRILLS

★ **4 Ft. Canedy-Otto Radial Drill, motor spindle, 11" column, new in 1942.**
No. 416 Baker, single spindle.
★ **21" Cincinnati-Bickford Direct Motor Driven Drill, single spindle.**
42" Barnes, sliding head.
Allen Sensitive Drill, four spindle.
No. 11 Natco Multiple Drill, 16 spindle.
★ **No. 3 Baush Multiple Drill, 20 spindle, No. 2 Morse taper, rectangular head 20" x 40".**

GEAR CUTTERS

No. 61 Fellows Gear Shaper, m.d.
No. 5AC Lees Bradner Gear Hobber.
No. 21 Barber Colman Gear Hobber.
No. 5—48" Cincinnati Automatic Gear Cutter.

GRINDERS

No. 22 Heald Rotary Surface.
76" Rogers Knife Grinder, type B.
No. 72A5 Heald Plain Internal Grinder.
No. 16-26" and No. 16-30" Blanchard Surface Grinder.
No. 72A3 Heald Gagematic Internal Grinder.
No. 70 and 75 Heald Internal Grinders.
No. 13 Brown & Sharpe Universal & Tool Grinder.
10" x 36" Norton Cylindrical Grinder.
10" x 50" Norton Cylindrical Grinder.
No. 2 Cincinnati Centerless.
★ **No. 3 Cincinnati Centerless Grinder, m.d.**

LATHES, ENGINE

★ **20" x 8' Sidney "Monotrol", 8 speed geared head, with taper attachment.**
30" x 12' Schumacher & Boye, c.d.
24" x 30' Lodge & Shipley, g.h.
16" x 6' Hendey, g.h.
★ **8" x 60" Fitchburg Lo-Swing, g.h.**

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★ **No. 4L Gisholt, 9¼" spindle, chucking.**
No. 1A, 2A, Warner & Swasey.
No. 4 Warner & Swasey Universal, c.d.
No. 3 Gisholt, g.h.
No. 6D Potter & Johnston Automatic Chucking and Turning Machine.
★ **42" Bullard VTL, New Era type.**

MILLS

No. 30 Universal Tri-Way Boring Mill, Timken bearing.
No. 4A Brown & Sharpe Universal, s.p.d.
No. 3B Milwaukee Plain, m.d.
No. 4 LeBlond Plain, c.d.
No. 1 Brown & Sharpe Universal, c.d.
No. 0-8 Cincinnati Plain Automatic, m.d.
18" Cincinnati Plain Mfg., s.p.d.
No. 3-36 Cincinnati Hydromatic Duplex, m.d.
4" Pratt & Whitney Spline Mill.
42" Bullard Vertical Boring Mill.

MISCELLANEOUS

No. 3 Long & Allstatter, Multiple Punch, m.d.
Schraner Crankshaft Lapping Machine, Model B.
8" x 7" Troy Vertical Steam Engine.
No. 6 Whiting Stake Riveter.

PLANERS AND SHAPERS

24" American Shaper, c.d.
28" Gould & Eberhardt, s.p.d.
★ **6" Pratt & Whitney Vertical Shaper.**

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No. 4B Marvel Hack Saw.
9" x 9" Peerless Hydraulic

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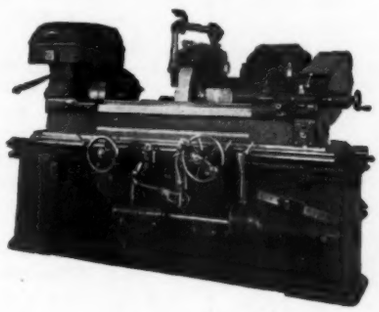

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10 x 50	14 x 50	18 x 120
10 x 72	14 x 72	24 x 96
10 x 96	16 x 50	24 x 240
	16 x 72	

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AUTOMATICS, Acme 9/16" & 1" Mod. C 5 spdle.
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AUTOMATICS, Gridley, 9/16", ⅞ & 1¼" Mod. G
AUTOMATICS, Cone, 1¼, 2½ & 3½" 4 spdle
CONOMATIC, 1½ & 1¾"—8 spindle, M.D.
AUTOMATICS, Gridley, ¾, 1¼, 1¾, 2¼" & 2¾, Model F, M.D.
AUTOMATICS, Gridley, 2¼, 3¼, & 5¼" S. S.
AUTOMATICS, Cleveland 1¼, 1½, 2, 2½, 3½ & 1¾" Model A, M.D.
AUTOMATICS, Cleveland ⅞, 1¼, & 2" Mod. B
AUTOMATICS, Cleveland 3½" 4 spdle. Mod. K4
AUTOMATICS, Potter & Johnston #5a & 6a, M.D.
BULLARD 36" New Era Borg Mill, M.D.
DRILLS, High Speed, B. B. 1 to 6 spindles
GEAR HOBBERS, #3 & 12 Barber-Colman, M.D.
GEAR SHAPERS, #7 High Speed, M.D. & #6
GENERATOR, Gleason Spiral Bevel Gear 10"
GRINDERS, Brown & Sharpe #2 & 3 Universal
GRINDER, Brown & Sharpe #11 Plain, M.D.
GRINDER, Heald #72 Hydraulic, 2 M.D.
GRINDERS, Diamond Surface #2, M.D.
GRINDER, Norton 10"x36" Hydraulic, M.D.
GRINDERS, Landis Hydraulic, 6"x18", M.D.
GRINDERS, Pratt & Whitney 12" Vert. Surface
LATHES, Hendey, E.B.M. type, 14"x7' & 8' M.D.
LATHES, Hendey, 16"x6' & 8' & 18"x10' M.D.
LATHES, Rockford, 18"x8' Geared Head, M.D.
LATHES, Turret, Warner & Swasey #4 G.H. M.D.
LATHES, Morey #3 G. H. Turret, M.D.
LATHES, Lo-Swing 4"x36" Seneca Falls
MILLING MACHINES, #2B Milw. & Vert. Hd.
MILLING MACHINES, Becker Vertical #5 & 6
MILLING MACHINES, Milwaukee #1B Plain & Universal #2 & 3B Plain, M.D.
MILLING MACHINES, #2B Rockford Universal
PLANER, Ohio 42"x42"x10' One Head, M.D.
PLANER-SHAPER, 30" Cincinnati M.D.
TAPPERS, Garvin #2 & 2X M.D.

OTT MACHINERY SALES, INC.

542 Second Avenue
Detroit 26, Mich.

MONA MEMBER

No. 1 Brown & Sharpe Hand Turret aLthe, M.D.
No. 1 Foster Hand Turret Lathe, M.D.
14"x6' Hendey Geared Head Lathe

MONA MEMBER

D. E. DONY MACHINERY CO.

47 Laurelton Road, Rochester 9, N.Y.

POWER PRESSES

BLISS, TOLEDO, V & O, ETC.
REBUILT — GUARANTEED

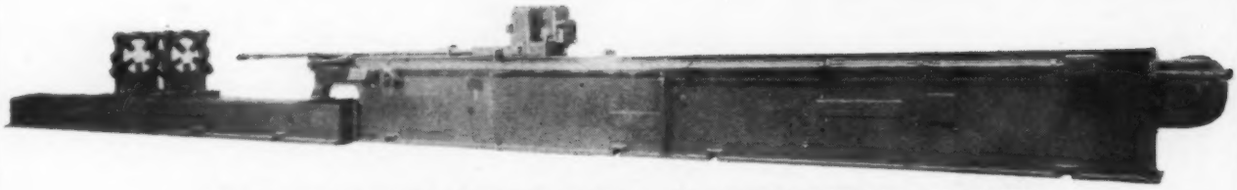
MONA MEMBER

JOSEPH HYMAN & SONS

Tioga, Livingston and Almond Streets
Philadelphia, Pa.

20′ BARNES HONING
PRACTICALLY NEW

IMMEDIATE DELIVERY FROM OUR STOCK



No. 6 BARNES HYDRAULIC HORIZONTAL HONER

6″ diameter capacity.
20′ spindle stroke.
Table working surface 22′ x 40″.
Maximum swing 40″.

This machine is complete with extra hones, blades, cradle supports, extension bars, Vickers hydraulic pump and coolant motor and pump.

We invite your personal inspection. ***Wire — Write — Phone***

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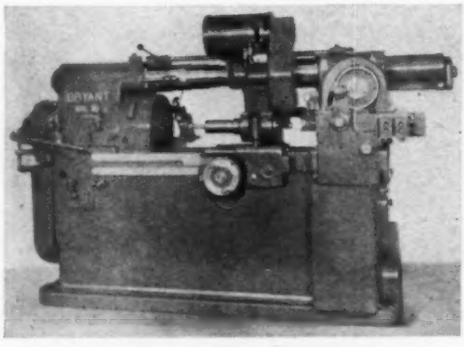
875 W. 120th STREET **CHICAGO 43, ILL.**

AN UNUSUAL OPPORTUNITY

We have 12 of these very modern BRYANT Automatic Hole Grinders, model 16-C-16″ for sale. These machines have seen very little use. NEW IN 1941. Original cost about $8000.00 each.

To be sold at $1850.00 each. Inspection can be made upon appointment in Detroit. Immediate Delivery. First come—first served. All machines complete, with many accessories.



ORIGINAL COST ABOUT $8000.00
Now $1850.00

LAURENS BROS. *Machine Tools*
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MACHINERY WANTED

1—Pratt & Whitney Profiler, table size 24″ x 30″.
1—54″ to 60″ Bullard Vertical Boring Mill. "CUT MASTER" for carbide tools.
2—#4 Plain Horizontal Millers. Condition must be equal to new.
2—#4 Universal Millers. Condition must be equal to new.
1—#1½B or #2 Pratt & Whitney Jig Borer.
5—#2 Brown & Sharpe (light type) Universal Millers (also plain).
6—#1 Bilton Automatic Gear Cutters.
6—Davenport Automatic Screw Machines, 1942 or later, up to ⅞″ capacity.
3—Van Norman Duplex Millers, any size from #½ up.
10—#2G Brown & Sharpe Automatic Screw Machines, 1942 or later.
3—15″ Potter & Johnson Shapers (cone or motor drive).
4—Grob Bros. Metal Band Saw Machines.

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LARGE STOCK ON HAND
Hasco MACHINERY COMPANY
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FOR SALE
Approximately 500 Danley Die Sets. Like New—just removed from production line of a large Aircraft Plant. Sizes 5″-30″.
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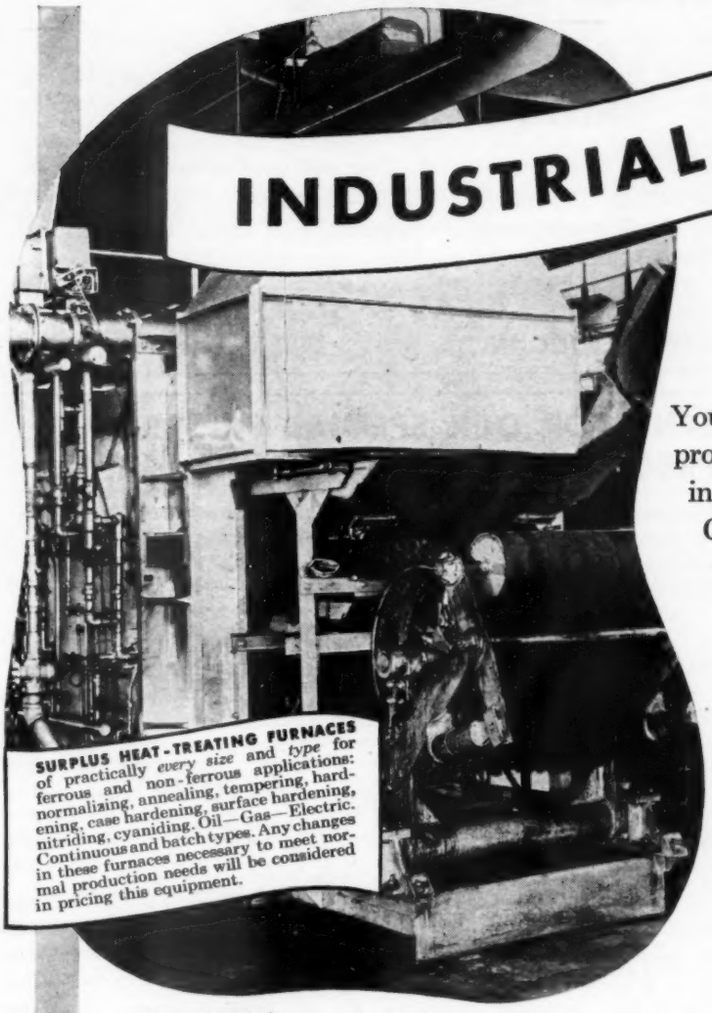
Phone GAlvez 1181

INDUSTRIAL EQUIPMENT

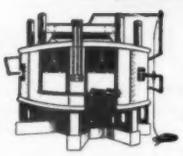
GOVERNMENT-OWNED SURPLUS
FOR SALE



SURPLUS HEAT-TREATING FURNACES of practically *every size* and *type* for ferrous and non-ferrous applications: normalizing, annealing, tempering, hardening, case hardening, surface hardening, nitriding, cyaniding. Oil—Gas—Electric. Continuous and batch types. Any changes in these furnaces necessary to meet normal production needs will be considered in pricing this equipment.

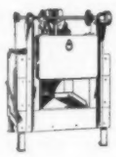
You can acquire *now* at good value, long needed production equipment—such as the heat treating furnaces shown in this advertisement. Check your operations today. Find out where additional or replaced equipment would cut your costs or speed processing. Then go over your needs with your nearest War Assets Corporation Regional Office*. From the vast quantities of surplus industrial equipment on hand you will be able to pick, in all likelihood, exactly what you need at a very low price.

**ROTARY HEARTH*



For heat treating in production operations. Semi-automatic operation and control.

**TEMPERING FURNACE*



For tempering small work in production or for the tool room or laboratory.

**INDUCTION HARDENER*

The latest development in controlled surface hardening by high frequency induction. A complete heat-treating unit that can be spotted strategically in the production line.

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VETERANS OF WORLD WAR II: To help you in purchasing surplus property from War Assets Corporation, a Veterans' unit has been established in each of our regional offices.*

CHECK THIS LIST FOR THE EQUIPMENT YOU NEED

Without obligation, make sure your name is on the list for complete information on the types of industrial equipment you need. Simply mail this coupon.

- ☐ Heat-treating furnaces (for all purposes)
- ☐ Gantry type cranes
- ☐ Extrusion Presses
- ☐ Electric and Pneumatic tools
- ☐ Centrifugal and rotary pumps
- ☐ Welding equipment
- ☐ Chemical equipment
- ☐ Thermal dryers-dehydrators
- ☐ Generator sets (internal combustion engine driven)
- ☐ Baling presses
- ☐ Electric copper cable
- ☐ Anti-friction bearings
- ☐ Bonded and coated abrasives
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277-2

A DISPOSAL AGENCY DESIGNATED BY THE SURPLUS PROPERTY ADMINISTRATION for Surplus Producers' and Capital Goods, Aircraft and Plants formerly handled by Reconstruction Finance Corporation . . . and for Surplus Consumer Goods formerly handled by United States Department of Commerce.

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(A SUBSIDIARY OF RECONSTRUCTION FINANCE CORPORATION)

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IN STOCK

No. 2H Milwaukee Vertical Milling Machine, motor in base. Latest type (6)

No. 4 Milwaukee Heavy Plain Milling Machine. Motor in base. Timken Brg.

No. 4-B Milwaukee Vertical Milling Machine

26"x25"x12' Ingersoll Adjustable Rail Milling Machine, 1 vertical head

42"x36"x18' Ingersoll Adjustable Rail Milling Machine, 4 heads

No. 118 Van Norman Production Milling Machine, Hyd. Feed. (2)

18"x8' Lodge & Shipley Lathe

36"x30' Lodge & Shipley Triple Geared Selective Head Lathe, 2 carriages

6.2" Denver Turret Lathe, chucking machine, motor in base

Denver Type 6R Turret Lathe, motor in base, A.C. & B.F., 2-9/16" cap.

18" Libby Turret Lathe, motor drive

No. 24HS Gould & Eberhardt Gear Hobber

36"x36"x8' Woodward & Powell Planer, 2 heads on rail, reversing motor drive

60"x38"x8' Gray Spiral Geared Widened Pattern Planer, 2 heads on rail

No. 72 Heald Internal Grinder, M.D.

No. 32 Lucas Hor. Boring Mach., 3¾" bar

No. 2 Rockford Horizontal Boring Machine

No. 27MB Smalley General Thread Milling Machine, motor drive & hydraulic trav.

No. 6 Lees-Bradner Thread Milling Machine

5' Fosdick Radial Drill, M.D. (2)

HILL-CLARKE MACHINERY COMPANY
651 Washington Boulevard
Chicago 6, Illinois

Boring Mills, 26"-42"-52"-72"-96.
Belt Cutters, 1"-1¼"-2"-2½" Acme-Landis
Press, Forging 1000 Ton United, Bt.-Hyd.
Planer, 36"x36"x12' Powell 4 Hds.
Planer, O. S. 60"x60"x14' D. & H., M.D.
Planer, 12'x12'x34', 4 Heads, M.D.
Profiler, #13 P. & W., B.D.
Shapers, 16"-20"-24"-36".
Shaper 36" Morton, Draw Cut

West Penn Machinery Company
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NINE — No. 2FU FOSTER FASTERMATIC UNIVERSAL TURRET LATHES

New 1940-41. Serials FU113 plus. Cost with accessories $12,840 each. Motor driven with 7½ H.P. motors, 220/440 volt, 60 cycle, 3 phase. With quantity of extra equipment: air cylinders, pilot heads, bars, bushings, angle holders, etc. Excellent condition. Price **$3750.00** each

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BRIDGEPORT 5, CONN. **Telephone 9-3393**

SEND FOR OUR SPECIAL PRICES OF PRECISION TAPPER GROUND TAPS

High speed tapper taps, bent and straight shank. Sizes ranging 3/56 to 10/32 in 90° bent shank. Sizes ranging ¼-28 to ½-20 NF in 90° & 180° bent shank. Sizing ranging ¼-28 to ¾-16 in Acme and straight shank 15" overall. ALL GOOD STANDARD BRANDS FOR IMMEDIATELY DELIVERY.

DE WITT TOOL COMPANY
173 GRAND STREET, NEW YORK 13, N. Y.
SEND US YOUR INQUIRIES

UNUSUAL VALUES

Blueprint machines, printer-washer-dryer
Drills, high speed single & multiple spindle
Drill, 21" Royersford Bk. Grd. Pr. Feed, New
Drills, sensitive, 2 and 4 Spindle
Drill #25 Foot-Burt, motor driven
Drills—New—18" Royal motor driven (10)
Gear cutter, Brown & Sharpe #3—26
Gear cutter, Gould & Eberhardt 42"
Grinder, Webster and Perks #1-¾ motor drive
22" Buffalo Pr. Fd. Motor Drive, New
16"x6' Hendey Lathe, Quick Change Gear
Magic Chucks, #1-2 & 3 and Collets
Pipe Machine, 8" Oster motor drive
Planer 24"x24"x6' Pease, motor drive
Punch & Shear, two ½" & ⅝" capacity
Shaper, 24" Gould & Eberhardt
Turret Lathe, 2" Acme & Warner & Swasey
Welders—Arc & Spot in Stock—New

THE OSBORNE & SEXTON MACHINERY CO
COLUMBUS, OHIO

AUTOMATICS

2—3½" R.A.S. National Acme bar feed Automatics. $10,800.00 each
3—1⅝" R.A.6 National Acme bar feed Automatics. $6,250.00
1—1¼" R.A.6 National Acme bar feed Automatic. $4,700.00
1—9/16" R.A.6 National Acme Automatic.
2—4¾" R.A.4 National Acme bar feed Automatics $10,800.00 each
4—3½" R.A.4 National Acme bar feed Automatics. $10,800.00 each
8—1½" 8 spindle Conomatic Screw Machines. $4,450.00 each
2—1½" 6 spindle Conomatic Screw Machines. $4,450.00 each
New 1941, threading, auxiliary and high speed spindles—lots of extra tooling.
Other sizes upon request.

R. V. OSMUN COMPANY
Automatic Specialists
406 Bloomfield Ave., Bloomfield, N. J.

POWER PRESSES

No. 96A Toledo Double Crank Bed 44 x 48"

No. 308A Bliss Straight Sided, bed 30 x 38", Tie Rod Frame

AARON MACHINERY CO.
45 CROSBY STREET NEW YORK, N.Y.

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Anything you want

that other readers of this publication can supply

OR—

Something you don't want

that other readers can use, advertise it in the

Searchlight Section of
American Machinist

TRUCK CRANES

A good selection of truck cranes from 5 tons up to 25 tons are available and if interested we would suggest you call us on the telephone collect and we will be glad to give complete information and arrange for an inspection.

1—Speeder B3—8 ton truck crane—6 pneumatic tires size 1100x24 30' boom.

1—6-7 Universal truck crane—6 pneumatic tires.

BRAND NEW
Delivered 4 months ago—used for 600 miles only. A ¾ yd Insley K-14 10 wheeler pneumatic tired Truck Crane—a Real Buy.

1—12 ton Byers truck crane—10 pneumatic tires—entirely rebuilt with Waukesha gas engine 40' boom.

15-18 ton P&H truck crane—70' boom—10 tires 1200x24. A real buy

1—7½ ton entirely rebuilt 7½ ton Speeder Model B2 with 50' boom—exceptionally good condition.

1—15 ton Northwest Model 3 truck crane with 10 tires 1100x24. Condition very good.

1—10-12 ton Northwest Model 2 truck crane with shovel and backhoe attachment—2 buckets.

1—Michigan truck crane and shovel of ⅜ yd. capacity. Condition good.

ECONOMY CO., INC., 49 VANDERBILT AVENUE, NEW YORK 17, N.Y.
Inquire about our "Pay as You Go Plan" **Telephones: MUrrayhill 4-2294, 4-2893, 4-2295, 4-2844, 4-2296, 4-8292**

FOR SALE

Jones 4½" bar horizontal boring mill, box table planer type. 40" x 120", geared head 12 speeds, outer bar support, 5 HP motor in column, bargain $3750.

Norton external Grinder, 14" x 96"

Pond Lathe, 30" swing x 30' centers, compound rest, 3 steady rests, $500.

Betts Vertical Boring Mill 10' table.

Detrick & Harvey open side planer, rail and side heads, table 25" x 8' $750.

Bullard 42" New Era vertical boring mill with side head, serial over 14,000, price $4000.

#13B Brown & Sharpe miller double overarm, motor in base, fine condition, $1100.

4 Lodge & Shipley 16" x 6' geared head engine lathes fine condition, oil heads, fine condition $1000. each.

2 Brown & Sharpe #3 vertical millers, fine condition, reasonable price.

Barber Colman automatic hob grinder, $1200.

Cincinnati hydromatic duplex miller 3-36, $1600.

Heald #22 rotary surface grinder, new 1939, $2200.

#11 LeBlond production lathe, new 1938, $800.

#3 Bryant internal grinder. $700.

3 New Britain Gridley automatic screw machines, model 61, new in 1942—6 spindle 1⅝", used less than 2 years, fine condition, with tapping attachment, chip conveyors, motors, $5900. each.

2 Acme Gridley RA 6 spindle 2⅝" bar machines, threading, new 1942, $8500. ea.

2 Conomatics, 6 spindle, 1½" bar machines, new 1942, with threading, $5600. each.

WANTED

Engine lathes 48" x 25' bed, less than 10 years old. 2 Lathes, 24" x 12 or 14' centers, one 24" x 5 or 6' centers, not more than 6 yrs. old. Bullard 42", 48", 54" late new era or cut master vertical boring mills. #3 Maxipress. 3A Warner & Swasey turret lathe, 6" hole in spindle. Gould & Eberhardt Hobber 36H. External Cylindrical Grinder 30" x 20' centers. Fosdick Jig Borer, 22" x 44" table. 2 Foster Fastermatics, model 2F. 200 ton Bulldozer. 5000 lb. drop board hammer. #2 Upset forging machine. Gisholt chucking turret lathe, 3½" hole in spindle. #5 Bardons & Oliver, 2½" hole in spindle. 20", 24", 32" shapers. #3 K & T universal millers. #2 MH Cincinnati milling machine. #2 vertical miller. #2 and #4 horizontal millers. 6" horizontal boring mill table or floor type. 15 to 20 ton horizontal broaching machine, K & T die sinker model D2. Planer Miller, 42" between housings. Rapid traverse Planers 48" x 14' or 16', 60" x 12' or 14'. Acme Gridley or New Britain Gridley 6 spindle Automatic Screw Machines 1" up to 2¼.

GENERAL MACHINERY & EQUIPMENT COMPANY

180 South 15th Street

HARRISBURG, PA.

CAN YOU BEAT THESE PRICES?

Money Back If Not Satisfied

8—AIR HYDRAULICS—NEW—2½ ton, 2" to 8" Stroke. Price $275 to $385.

BRAKE PRESS, POWER: Robinson 8½'x¾" cap.

BRAKE PEXTO: 38" FOOT—16 gauge. Price $100.

BORING MILL: Horizontal Gisholt 4", Serial 5/962 with 8 arbors, b.g. knee type, rapid traverse, no motors. Price $475.

DRILL PRESS: 60" swing, No. 5 Morse taper, h.d. Price $150. Aurora—24" b.g. mot. Price $175.

GRINDERS: Surface Reid No. 2-A, mag. chuck 6"x18" motor (1944). Like new.
Robot— No. 2 Mag. Chuck. 6"x18" motor (1944) Like New.

2—HAMMERS: Power—50 and 100 lbs. Price $100 each.

MILLERS: (2) Moray No. 12M Vertical Miller & Profiler (1941) Power feed, completely motorized, 2 spindle, original cost $3700 each. Our Price $750 each.

PIPE: Hurlburt, 3" Cut-Off, Heavy Duty. Price $50.

MACHINES: (6) Saunders, capacities ½" to 4" with dies.

NIPPLE MACHINE: Landis 2 heads, dies, Q.C. 2"-4" cap.

POWER PRESSES

3—MINSTERS #40-S, 100 ton, 24"x24" (1944) S.S.

1—BLISS #162, 32 ton, 19"x13" (1941), S.S.

1—WATERBURY Farrel #5012, 60 ton, 50"x13" (1941) Arch geared.

1—CAMERON #29, 60 ton open back inclin. O.B.I. 45 deg. only.

1—GARRISON, 250 ton, 66"x36", S.S. geared.

1—BLAKE & JOHNSON #3, 20 ton, 17"x13", O.B.S.S.

1—BLAKE & JOHNSON #5, 30 ton, 13"x13", Pillar

1—STOLL #40, 40 ton, Fly in back.

1—DEEP DRAW PRESS, 50 ton, 12"x12", Deep Draw.

2—BLISS #68-C, 35 ton, Arch double action.

2—306½, 150 ton, 27"x27", St. Side Geared.

1—Ferracute #E-4 and TOLEDO #9C.

RIVETER: Farnham Countersinking Mill, 36" Reach, Hydraulic, motorized, 1942, Cost new $1755. Our Price $375.

RADIAL DRILL: 3' Bickford Motor & Gear Box. Price $450.

SHEAR: Loy and Nowrath—Single end—motorized. Price $550.

THREAD MILLER: Lees Bradner #6 Standard. Price $750.

25—TURRETS: New—Denver 6" Chuckers—geared head. Universal (Fraction of cost)
(1) Midland—No. 5 (1943) 2½" collet cap., full Universal, motorized, bar feed, heads of collets and turret tools, Cost $7900. Our Price $3500.

LATHES: LeBlond 16"x6' QC motor. Price $850.
Hendey 16"x6' QC Taper meter. Price $750.
Fay & Scott 16"-36" swing x 4'-9' centers, sliding gap motor. Price $1050.

LATHES: American—Q.C. 14"x8' Motor. Taper Attach. Price $850.

TAPPER & THREADER: Bakewell #1 Precision plus Lead Screws (1944). Cost New $1700. Our Price $550.

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KINGS COUNTY MACHINERY EXCHANGE
194 Atlantic Avenue, Brooklyn 2, N. Y.

LATEST TYPE EQUIPMENT

Porter-Cable BG-8" Belt Sander, 1942 Mfg.
Natco D-5 Multiple Drill
Blanchard #18-36" Grinder, 1942 Mfg.
Onsrud #225 Router, 1942 Mfg.

GRINDERS

Norton Cam-mtr. dr.-late type
Marschke 18" D. E. Ball Bearing Disc-mtr. dr., 1943
#2 Cinn. Centerless Grinder
H & G Chaser-excellent condition
Sellers ¼" to 3" cap. drill grinder 1942

LATHES

Prentice Bros. 24"x18" Grd. hd-mtr. dr.
Blaisdell 24"x10' LCG-TA
14"x8' American 12 speed G.H. T.A. Motor-in-base, collets, late type
Pratt and Whitney 14"x6' SQCG—TA
Hardinge Pres—on Bench with Equip.

TURRET LATHES

Jones and Lamson 2¼x24" Steel hd—1935 Mfg.
Foster 1" geared head
Warner and Swasey #4 Mtr. Dr.—inst. drive-all-bar equipment

MISCELLANEOUS

Cincinnati 24" Duplex Miller—#50 Taper—Mtr. dr.—excellent
#2M Potter and Johnson Miller, Dual table
30"x30"x8' Gray 2-head Planer, arr: factory Mtr. dr.
36" Gisholt Vert. Boring Mill, 2 Hd. Arr: M.D.
#DT 42½B Pels Automatic Beam Shear
36"x36"x10' Powell Planer, 1 side head, 1 rail head
#1A Gorton (Pantograph) Engraving machine
48" Apron Folder (power) 14 gauge
72" 14-gauge Dreis and Krump Apron Brake
30"x30"x10' Putnam Planer, 2 head, box bed
5' Western Radial Drill
3000# Chambersburg Board Drop Hammer

UNITED MACHINERY & TOOL CORPORATION

35 Hermon St., Worcester 8, Mass.

McDONALD USED MACHINERY

Rockford 24" Shaper, S.P.D. gear box.
Cleveland O.S. Planer 36"x8', 2 hds.
American 4' Radial Drill, encl. hd.
Cincinnati D. H. Planer 36"x36"x10', 2 hds.
Barnes geared Camelback Drill Press, 4 sp.
Bullard Vert. Turret Lathes, 24" & 36" S. Head
Baush 44" M.D., Vert. Boring Mill
Cin-Bick (Super Service) 3' M.D. Radial
American 24" x 12' grd. hd. Lathe, m.d. q.c.g.
Amer. 4-ton vert. Hydr. Broach.
Blanchard Vert. Surf. Grinder, 26 rd. chuck.
Cincinnati #2 Centerless Grinder.
Diamond Horiz. Surf. Grinder, 12"x60" Table.
L & S 18" (20")x10' M.D., Grd. Hd., Q.C.G. Lathe
Cincinnati 1-M grd. hd., Univ. tool room Miller.
Cincinnati No. 5 H.P. grd. hd. S.P.D. Pl. Miller.
Milwaukee No 3-B Vert. Miller grd. hd., m.d.
Cincinnati No. 3-B Vert. Miller grd. hd., m.d.
Cincinnati 48" Auto Pl. Prod. Miller, S.P.D.
W.&S. No. 2A Univ. Turret Lathe, S.P.D.
Foster No. 2F Fastermatic grd. hd. Turret Lathe, M.D.

MDNA

McDONALD MACHINERY CO.
1531-35 N. B'way., St. Louis 6, Mo.

10½' L & A Plate Shear
Type G

1⅛" capacity, 36" Gap
M.D.

AARON MACHINERY CO.
45 CROSBY STREET NEW YORK, N.Y.

FOR SALE
600 TON HYDRAULIC PRESS

Watson Stillman rebuilt 48" single daylight opening downward double acting ram 16" dial by 31" stroke, platen 24"x24" with clear space left to right 30¾" between 5½" dia. strain rods. We will purchase your Surplus Equipment.

UNIVERSAL HYDRAULIC MACHINERY CO.
285 Hudson Street New York, N. Y.

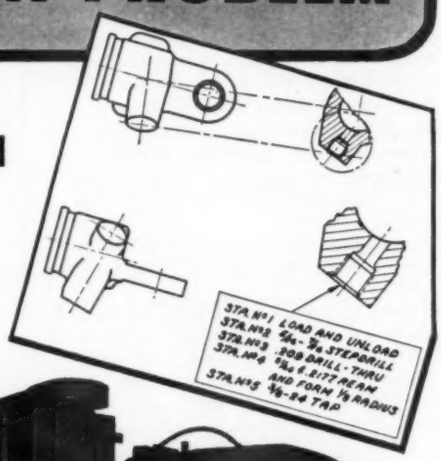
FOR EVERY
BUSINESS WANT
"Think Searchlight *First"*

NOW WE CAN TELL YOU ABOUT THE SECOND HALF OF

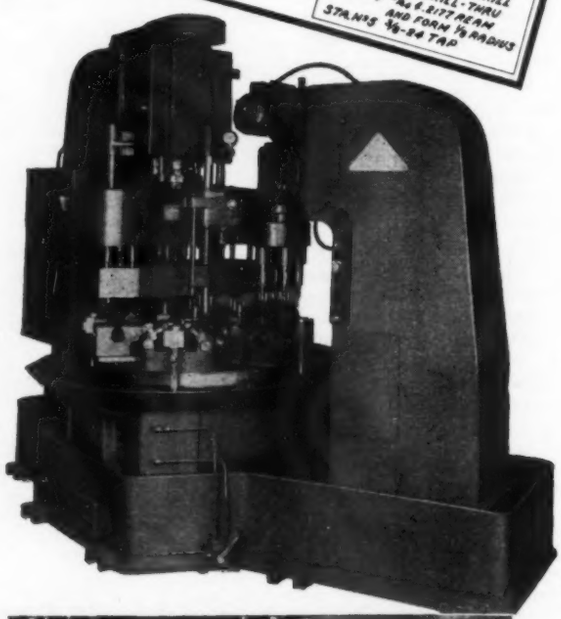
The OPERATION that SIMPLIFIED a COMPLEX PRODUCTION PROBLEM

(The first half was described last month)

AGAIN STANDARD LEMAIRE HYDRAULIC UNITS PLAYED AN IMPORTANT PART


STA. N°1 LOAD AND UNLOAD
STA. N°2 13/64 - 25/64 STEP DRILL
STA. N°3 .209 DRILL-THRU
STA. N°4 13/64 & .2177 REAM AND FORM 1/8 RADIUS
STA. N°5 3/8-24 TAP

After being drilled, reamed, bored, counterbored, chamfered, and tapped on the special LeMaire Machine we described last month, the wheel cylinders come to this special machine for their next operations.



Here, the first operating station step-drills to 5/16 and 7/16, the next station drills through-holes .209 diameter, the fourth station reams .3281 and .2177 diameters and also forms 1/8" radius; and the last station taps 3/8—24.

The fixture of each station holds 4 parts clamped by air cylinder and released by cam rail. Positive location and alignment is assured by nesting locating pins from fixtures into inverted bushings in bushing plate.

By having 4 parts loaded in the fixture, a complete set of wheel cylinders is finished at each index of machine; thereby, an even level of stock parts is maintained. Accuracy is assured by drilling, forming and tapping with one setting in fixture. Maximum production with minimum handling is obtained. This machine produces opproximately 675 pieces an hour.

The machine *(designed and built by LeMaire)* consists of a 5-station, 54" automatic index table on a special fabricated base supporting two columns. On one is mounted a standard LeMaire No. 5000 self-contained Hydraulic Drilling Unit and on the other a LeMaire No. 150 lead screw Tapping Unit.

More and more manufacturers are realizing the wide versatility offered in these compact, hydraulic power units, and the worthwhile economies they produce in the building of special purpose machines.

We'll gladly send you folder containing full information that shows how these Twin Ram Units can be utilized to bring you top efficiency with increased production.

LeMaire

LEMAIRE TOOL & MANUFACTURING CO., 2657 SO. TELEGRAPH RD., DEARBORN, MICHIGAN

Designers and Builders of unit and way-type machines for single or multiple spindle drilling, boring, reaming, tapping, etc . . . Twin Ram Hydraulic Power Units . . . Match-it Gear Chucks

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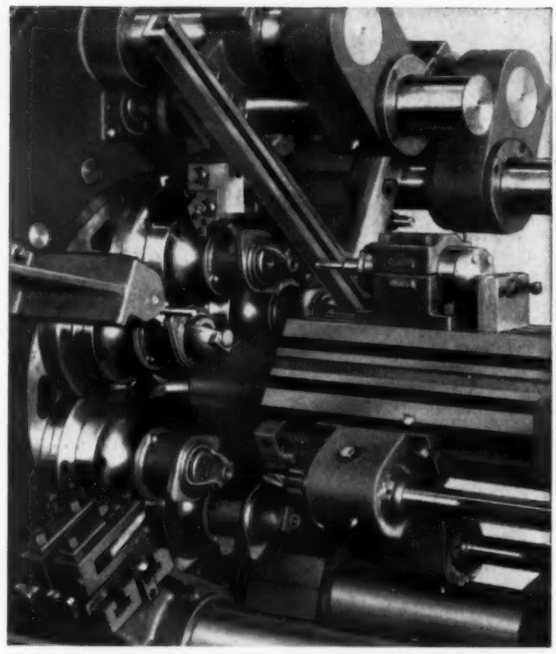
LEADERSHIP

PROVED BY HUNDREDS OF CASE HISTORIES...

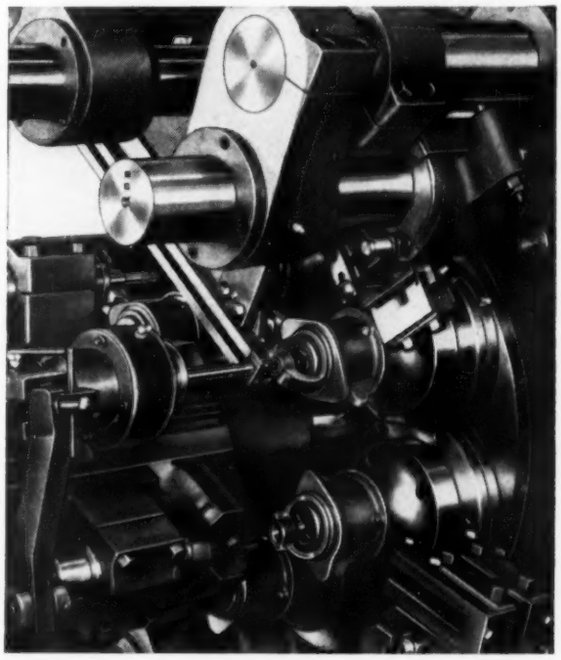
An excellent example of the advantages of New Britain exclusive features is the machining of the starter housing illustrated above. The longitudinal motion of the swinging type forming arm, (an exclusive feature of New Britain Multiple Spindle Automatic Chucking Machines) does the necessary back boring, making it unnecessary to handle this operation on another machine.

The piece is turned and bored within limits of plus or minus .001, and the finished part fits perfectly without the need of further machining. Another interesting feature of the job is a bushing, magazine fed, inserted in the fifth position, and broached in the sixth while the back boring and back turning are being done. Still another feature is the installation of a swinging stop on the first position to regulate the correct distance to the tools . . . a fool-proof aid to the machine operator. Sixteen operations are performed in a single cycle, and only 15.5 seconds are required to convert the rough casting into a finished part . . . 232 pieces per hour.

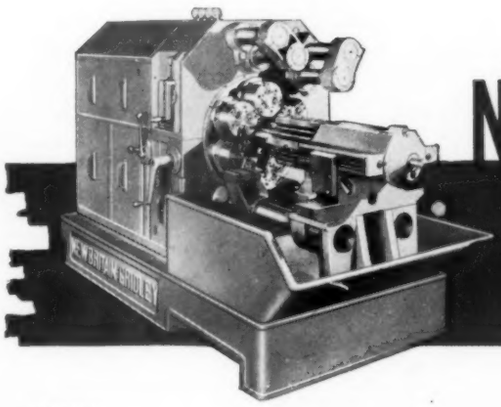
When you make the investment required to purchase automatic chucking or bar machines, be sure you get the *adaptability* of New Britains. They will maintain high production and low cost per piece, even on unusual requirements. The New Britain sales engineer in your area will be happy to show you how New Britain exclusive features can be used to advantage in connection with your automatic chucking machine requirements.



FRONT VIEW—Entirely open end construction provides accessibility for simplified chucking, cutting tool and attachment setup.



REAR VIEW—Wide open end construction provides extra large chip space . . . accessibility from three sides and from above that permits excellent visibility and easy tool adjustment.



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Increase production and improve the quality of your products by using Timken Seamless Steel Tubing. Tell us about the part you make. A member of our technical organization will be glad to help you select the size, finish and analysis that best suits your needs. Steel and Tube Division, The Timken Roller Bearing Company, Canton 6, Ohio.

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